The Only Journal With a Paid Circulation in the Rock Products Industry

Rock Products

Entered as second-class matter, July 2, 1907, at the Chicago, Illinois, Postoffice, under the Act of March 3, 1879.

Published Every Other Saturday by

Tradepress Publishing Corporation

542 South Dearborn Street, Chicago

MEMBER A. B. C. MEMBER A. B. P.

W. D. CALLENDER, President
N. C. ROCKWOOD, Vice-President
GEO. P. MILLER, Treasurer
C. O. NELSON, Secretary

NATHAN C. ROCKWOOD, Editor

H. E. HOPKINS, GEO. M. EARNSHAW, Associate Editors

CLINTON S. DARLING, Promotional Manager

C. A. BRESKIN, Advertising Manager
E. M. GIBSON, Assistant Manager
J. K. COSTELLO, Central Rep.
A. B. SANGER, Eastern Rep.

GEO. P. MILLER, General Manager

SUBSCRIPTION—Two dollars a year to United States and Possessions. Three dollars a year to Canada and foreign countries. Twenty-five cents for single copies.

TO SUBSCRIBERS—Date on wrappers indicate issue with which your subscription expires. In writing to have address changed, give old as well as new address.

Volume 25 October 7, 1922 Number 20

CONTENTS

At the Mining Show

Next week ROCK PRODUCTS will have a booth at the National Exposition of Mines and Mining Equipment —an auxiliary of the Twenty-fifth Annual Convention of the American Mining Congress. In our booth will be an exhibit of sand, gravel, crushed stone, lime, cement, gypsum, phosphate rock, talc, slate, diatomaceous earth, slag, etc., including a very interesting and complete collection of limestones from various corners of the United States. This exhibit will be in charge of a member of ROCK PRODUCTS staff who has traveled from one end of the country to the other visiting operations, and who has had an important part in collecting our exhibits.

The production and preparation for the market of rock products is a vast and important part of the mining industry. Yet it is not generally recognized as a part of the mining industry. If it was, there would not be so much trouble impressing government officials that cars are needed for stone and gravel as well as coal. If the general public understood better the technical nature of quarry and gravel pit operations, they would become more accustomed to accepting the production of such operations at a fair price, as a manufactured commodity, and not as so much "dirt."

The editors and publishers of ROCK PRODUCTS believe that one of the means it has of serving the whole industry is to give publicity to the complicated and technical nature of the rock products industries; so they let no opportunity pass of reminding mining men and the public that it stands for a real mining industry.

* * *

Serving the Reader Going and Coming

Not long ago in this column we referred to an inquiry from a reader asking where he could buy pulverized limestone of a certain quality in a certain locality. The other day a letter came from this reader informing us that he had been in touch with several of our subscribers, from one of whom he has already purchased two carloads of stone, and expects to purchase many more. He thanks us for connecting him with just the material he wanted.

ROCK PRODUCTS, from its long and intimate association and high standing in the industries, has unusual facilities for serving as a meeting-ground of buyers and sellers of rock products. If you want some special product; if you have some special product to dispose of; if you want to make some special product—the staff of ROCK PRODUCTS will be at your service for the asking.

The Only Journal With a Paid Circulation in the Rock Products Industry

Rock Products

Entered as second-class matter, July 2, 1907, at the Chicago, Illinois, Postoffice, under the Act of March 3, 1879.

Published Every Other Saturday by

Tradepress Publishing Corporation

542 South Dearborn Street, Chicago

MEMBER A. B. C. MEMBER A. B. P.

W. D. CALLENDER, President
N. C. ROCKWOOD, Vice-President
GEO. P. MILLER, Treasurer
C. O. NELSON, Secretary

NATHAN C. ROCKWOOD, Editor

H. E. HOPKINS, GEO. M. EARNSHAW, Associate Editors

CLINTON S. DARLING, Promotional Manager

C. A. BRESKIN, Advertising Manager
E. M. GIBSON, Assistant Manager
J. K. COSTELLO, Central Rep.
A. B. SANGER, Eastern Rep.

GEO. P. MILLER, General Manager

SUBSCRIPTION—Two dollars a year to United States and Possessions. Three dollars a year to Canada and foreign countries. Twenty-five cents for single copies.

TO SUBSCRIBERS—Date on wrappers indicate issue with which your subscription expires. In writing to have address changed, give old as well as new address.

Volume 25 October 7, 1922 Number 20

CONTENTS

At the Mining Show

Next week ROCK PRODUCTS will have a booth at the National Exposition of Mines and Mining Equipment —an auxiliary of the Twenty-fifth Annual Convention of the American Mining Congress. In our booth will be an exhibit of sand, gravel, crushed stone, lime, cement, gypsum, phosphate rock, talc, slate, diatomaceous earth, slag, etc., including a very interesting and complete collection of limestones from various corners of the United States. This exhibit will be in charge of a member of ROCK PRODUCTS staff who has traveled from one end of the country to the other visiting operations, and who has had an important part in collecting our exhibits.

The production and preparation for the market of rock products is a vast and important part of the mining industry. Yet it is not generally recognized as a part of the mining industry. If it was, there would not be so much trouble impressing government officials that cars are needed for stone and gravel as well as coal. If the general public understood better the technical nature of quarry and gravel pit operations, they would become more accustomed to accepting the production of such operations at a fair price, as a manufactured commodity, and not as so much "dirt."

The editors and publishers of ROCK PRODUCTS believe that one of the means it has of serving the whole industry is to give publicity to the complicated and technical nature of the rock products industries; so they let no opportunity pass of reminding mining men and the public that it stands for a real mining industry.

* * *

Serving the Reader Going and Coming

Not long ago in this column we referred to an inquiry from a reader asking where he could buy pulverized limestone of a certain quality in a certain locality. The other day a letter came from this reader informing us that he had been in touch with several of our subscribers, from one of whom he has already purchased two carloads of stone, and expects to purchase many more. He thanks us for connecting him with just the material he wanted.

ROCK PRODUCTS, from its long and intimate association and high standing in the industries, has unusual facilities for serving as a meeting-ground of buyers and sellers of rock products. If you want some special product; if you have some special product to dispose of; if you want to make some special product—the staff of ROCK PRODUCTS will be at your service for the asking.

Shaft sinking with DDR-13 "Jackhamer" Trade Mark Reg. U. S. Pat. Office

Where rock is hard and delays are costly

The DDR-13 "Jackhamer" is the ideal drill for shaft sinking through very hard formations. Its weight, extreme ruggedness and powerful blow combine maximum drilling speed with least delay for repairs. The "Jackhamer" is a superior type of self-rotating hand rock drill. It has established an enviable reputation for fast drilling, low upkeep cost, efficiency and durability.

The "Jackhamer" is now made in five weights. The three largest ones are made for use with steam or compressed air. These may also be equipped with or without arrangement for feeding water as well as air through the hollow piston and drill steel to the bottom of the drill hole to allay the dust and remove the cuttings.

Although "Jackhamer" drills are principally used for down-hole drilling and for service where the machine may be held in the operator's hand, mountings are made for the three larger sizes when they are used for drifting or tunneling work.

Request Bulletin No. 4046

INGERSOLL-RAND COMPANY, 11 Broadway, New York

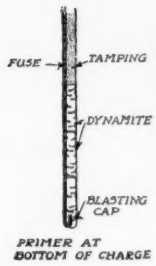
262-JD

Ingersoll-Rand

When writing advertisers please mention ROCK PRODUCTS

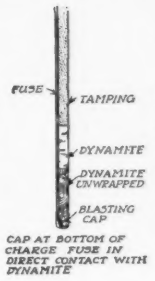
Dynamite Efficiency Depends upon Proper Priming

Load Dynamite the *Wrong* Way and You *Lose* Money



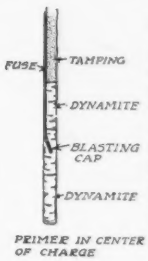
Here is one WRONG way:

For instance, the cap with fuse should not be placed at the bottom of the hole like this as the side spit of the fuse would be likely to set fire to the dynamite.



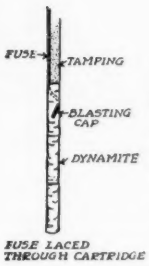
—here is another

This is also bad practice as the cap is pointed *away* from the charge instead of toward it and the fuse is also likely to set fire to the dynamite before the cap explodes.



—and another

Even the middle of the charge is not the right place to put the primer as the top cartridge does not receive the full force of the cap and the fuse may ignite the powder that touches it.



—still another

Lacing the fuse through the priming cartridge is bad practice. It nearly always lets the fuse side spit into the dynamite.

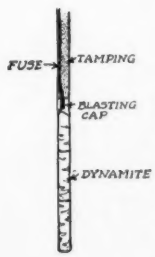
Another WRONG way:

This kind of loading, without tamping, is expensive and inefficient as the top cartridge wastes most of its force blowing out the hole. The Bureau of Mines reports that tamping increases the effectiveness of high explosives enormously

—and another

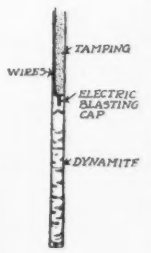
If the holes are full of water the cartridges of dynamite should not be slit as water affects nearly every kind of dynamite except gelatin.

Load Dynamite the *Right* Way and You *Save* Money



The RIGHT way:

This way, with the cap in the top of the *top* cartridge, pointing *down* toward the bulk of the charge, with lots of tamping and no part of the fuse touching the powder will give you a perfect shot every time.



Another RIGHT way:

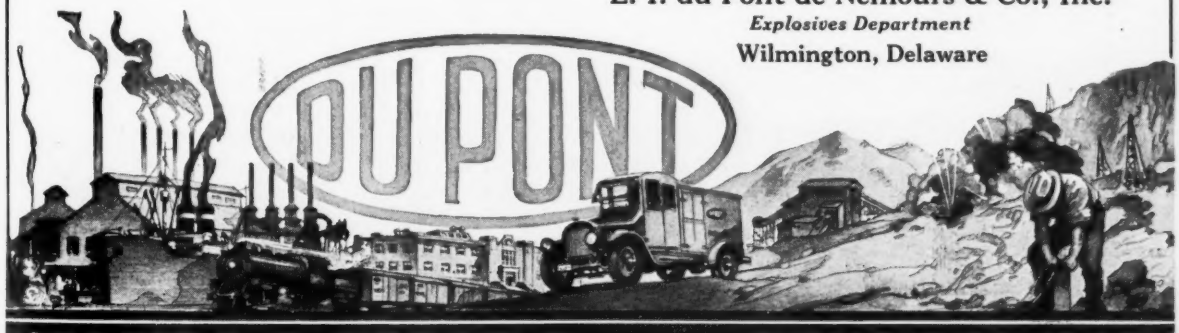
Or even if you fire electrically, you will get best results this way as the electric blasting cap is placed so as to exert its *maximum* detonating effect on *all* the explosive in the charge.

Branch Offices:

Birmingham, Ala.	Pittsburgh, Pa.
Boston, Mass.	Portland, Ore.
Buffalo, N. Y.	St. Louis, Mo.
Chicago, Ill.	San Francisco, Calif.
Denver, Colo.	Scranton, Pa.
Duluth, Minn.	Seattle, Wash.
Huntington, W. Va.	Spokane, Wash.
Kansas City, Mo.	Springfield, Ill.
New York, N. Y.	

Du Pont Products Exhibit
Atlantic City, N. J.

E. I. du Pont de Nemours & Co., Inc.
Explosives Department
Wilmington, Delaware



EXPLOSIVES ~ SERVICE

On the Toughest Loading Job—the Jeffrey TANKTRED Loader Meets Every Requirement

JUST the machine needed where material is hard or compact, the ground soft or uneven, or where large quantities of material must be moved quickly and at low cost.

The TANKTRED Loader will not only **load** loose materials without the aid of hand shovelers or mechanical feeding devices, but will readily **dig** hard material.

Has Two Speeds, both Forward and Reverse — Fast Speed for moving machine, and Slow Speed for feeding into the material.

Capacity, 1½ to 2 cubic yards per minute of Sand, Gravel, Crushed Stone, Coal, Coke, Cinders and similar materials. Will load crushed stone maximum size pieces through 3½ inch ring—Maximum size coal, 8-inch lumps.

An easily detachable Scraper or Clean-Up Device enables machine to pick up small scattered piles or windrows of road material. A Measuring Hopper can also be supplied.

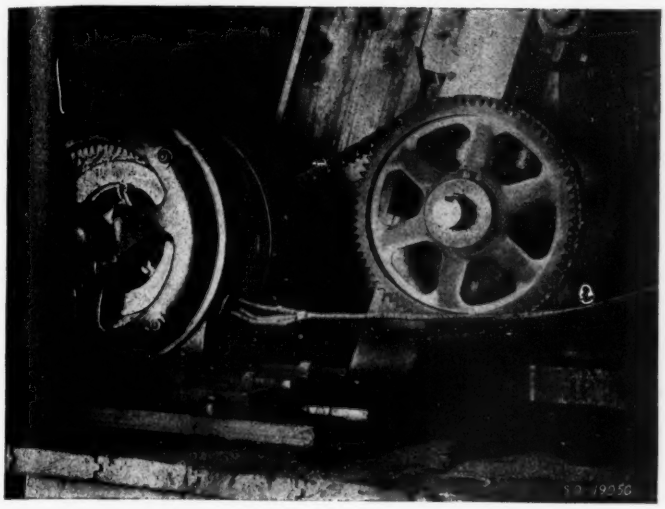
Special Terms and a few choice territories to offer to Live Agents, for the sale of Jeffrey Portable Bucket Loaders and Portable Belt Conveyors.

Ask for details

The Jeffrey Mfg. Co., 935-99 North Fourth Street Columbus, Ohio

JEFFREY

MATERIAL HANDLING MACHINERY



10 HP. Morse Silent Chain Driving Wet Clay Elevator in ceramic plant. Chain ¾ in. pitch, 2½ in. wide. Speed 1220 F.P.M. Sprockets, 17/79 teeth. 1150/245 R. P. M., 24 in. centers.

Where Belts would be abraded or rotted and Gears would wear or waste power

The process industries are particularly liable to offer transmission problems with peculiar features. This elevator, handling wet clay in a ceramics plant, would be a poor place to put a belt. It probably would not stand up under constant moisture, besides slipping and wasting power even normally. You'd scarcely drive such an elevator by a gear drive.

MORSE CHAINS are cheapest to buy in the long run.

BEST

In Material
In Workmanship
In Design

MORSE CHAINS

answered the problem. They stand up here, and will stand up anywhere, because, even where highly abrasive dusts or corrosive gases and liquids must be contended with, they can be completely enclosed, and run in oil.

MORSE CHAINS deliver 99% of the power. They not only are as flexible as a belt, and positive as gearing, but they do not wear like gears or stretch like belting. They cost less to maintain than either.

Your process doubtless has many places where a dependable, semi-permanent efficient transmission would eliminate much waste and cut costs. Won't you call on our engineers to show you how MORSE CHAINS can do this for you? Write our nearest office.

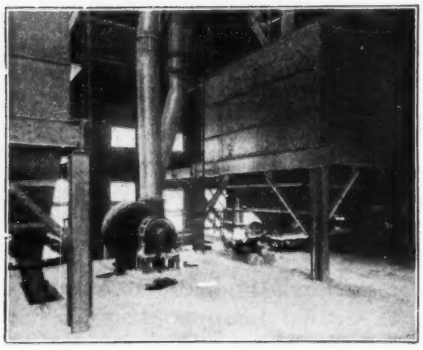
MORSE CHAIN CO., ITHACA, N. Y.

LARGEST MANUFACTURERS OF SILENT CHAINS IN THE WORLD

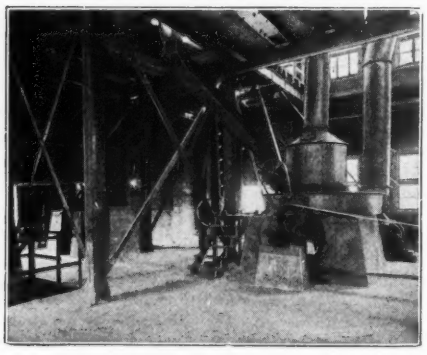
Morse Engineering Service — *Assistance Without Obligation*

ATLANTA, GA.—Candler Bldg., Earl F. Scott & Co.
BALTIMORE, MD.—1402 Lexington Bldg.
BOSTON, MASS.—141 Milk Street
CHARLOTTE, N. C.—404 Commercial Bank Bldg.
CHICAGO, ILL.—Merchants L. & T. Bldg.
CLEVELAND, OHIO—Engineers Bldg.
DETROIT, MICH.—1361 Abbott Street
KANSAS CITY, MO.—Finance Bldg., Morse Eng'rg Co.
NEW YORK CITY—30 Church St.
MINNEAPOLIS, MINN.—So. 3rd St., Strong-Scott Mfg. Co.
MONTREAL—St. Nicholas Bldg., Jones & Glassco Reg'd
PHILADELPHIA, PA.—Fuller Bldg.
PITTSBURGH, PA.—Westinghouse Bldg.
SAN FRANCISCO, CAL.—Monadnock Bldg.
ST. LOUIS, MO.—Chemical Bldg., Morse Eng'rg Co.
TORONTO—Bank of Hamilton Bldg., Jones & Glassco, Reg'd
WINNIPEG, MAN.—Dufferin St., Strong-Scott Mfg. Co.

"Morse" is the Guarantee Always Behind the Efficiency, Durability and Service



Raymond Special Exhaust Fan Direct Connected to Motor



Raymond Roller Mill with Gypsum Dryer in Background at Left

Raymond Roller Mills For Hydrated Lime

For those producers of Hydrated Lime who have a high grade material from which they do not wish to remove the impurities such as core, sand, and over burned lime, Raymond Roller Mills will give just the kind of finished product wanted.

They will reduce all of the Hydrate, including the impurities, to a fine uniform powder which is Air-Separated to remove oversize material, and deliver finished product direct to storage bins above the bagger.

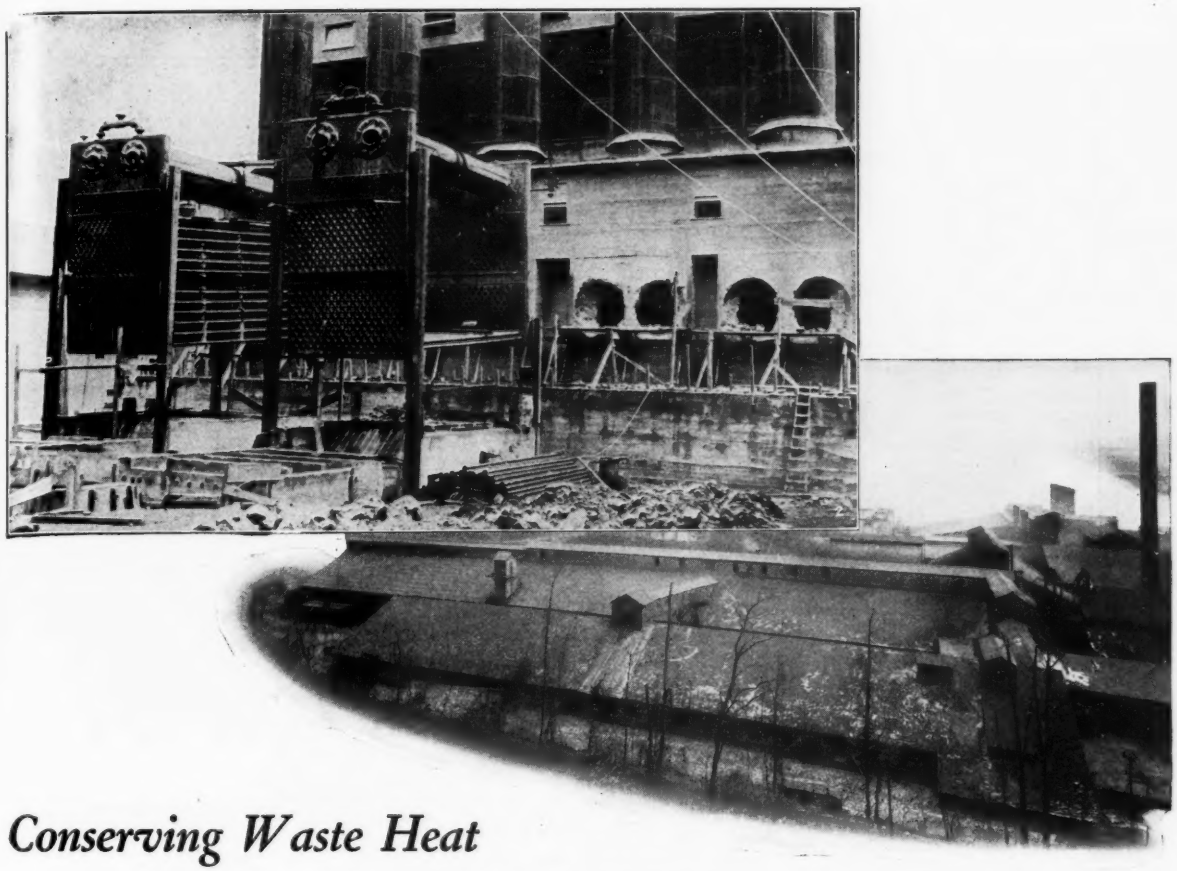
The grinding is done at an exceedingly low cost for power and repairs.

We invite correspondence from those who feel that all the lime can be ground up without removal of impurities and especially those who are now grinding on some other type of mill, as we feel that the figures we now have on operating costs will show that Raymond Roller Mills will pay for themselves in one to two years' time.

Raymond Bros. Impact Pulverizer Co.

1301 North Branch Street Chicago, Ill.

Western Office: 1002 Washington Bldg., Los Angeles, Calif.
Eastern Office: 50 Church St., New York City



The upper illustration shows two of four Edge Moor Waste Heat Boilers having a total of 2680 H.P., in course of installation at the plant of the Alpha Portland Cement Co. at Alsen, New York. The lower illustration shows view of the Martin's Creek, Pa. plant of the same company where three 749 H. P. boilers have been installed.

Conserving Waste Heat

THE first waste heat boiler plant in the cement industry to attract widespread attention was designed and built by the Edge Moor Iron Company.

It was the first distinctly successful waste heat boiler plant, and was the first installation of Edge Moor Waste Heat Boilers. After starting the waste heat plant, the old boilers in the power house were shut down, being merely held in reserve as a stand-by plant in case of emergency.

Properly designed waste heat plants will pay for themselves in two to three years.

The power economies of the many similar installations in the cement, steel, coke and other industries have emphasized the supremacy of Edge Moor Waste Heat Boilers.

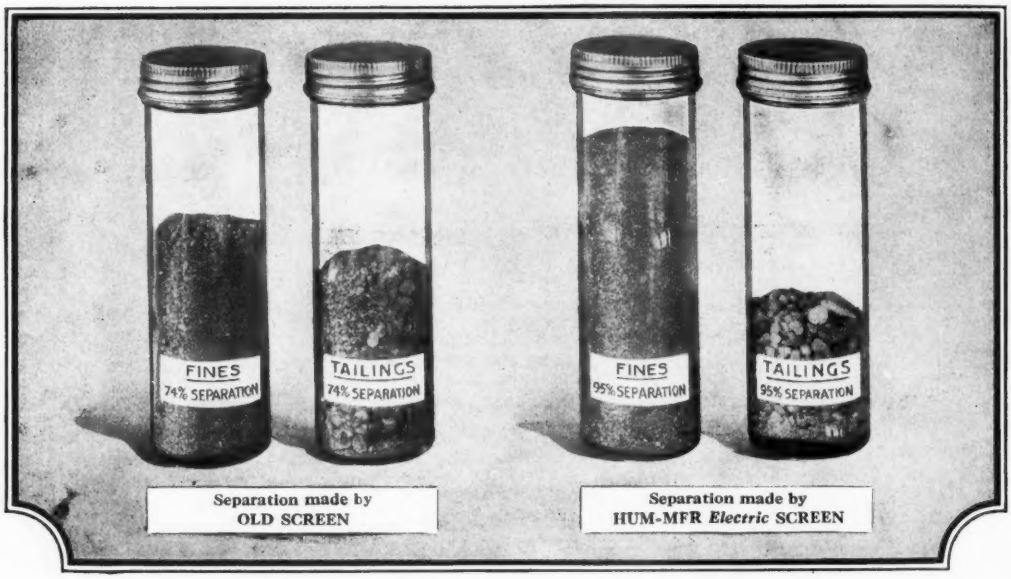
An interesting booklet on this subject will be mailed to you on request.

EDGE MOOR IRON COMPANY
Established 1868
EDGE MOOR, DELAWARE
New York — Boston — Chicago — Pittsburgh — Charlotte — St. Paul

EDGE MOOR BOILERS
EDGE MOOR, DEL. U.S.A.

EDGE MOOR Water Tube BOILERS

FOR INCREASED FUEL ECONOMY



Separation made by OLD SCREEN

Separation made by HUM-MER *Electric* SCREEN

Did the HUM-MER Pay?

DOES a 95% separation as compared to a 74% separation pay?

Compare the above bottles showing what the HUM-MER Electric Screen accomplished for a large refractories company.

Note that 21% of material formerly left in the tailings is now recovered by the HUM-MER.

Based on the former production of fine material, this is an increase in tonnage of more than 28%.

This is only one of hundreds of instances where the HUM-MER has proved its ability to make screening more profitable.

Screen vibration so positive, so powerful, that a man can stand upon the screening surface without diminishing the vibration is responsible for the wonderful sorting action obtained with the HUM-MER.

The "pull" that produces this wonderful vibration is the same as that of the electro-magnetic hoist which is capable of lifting tons of metal.

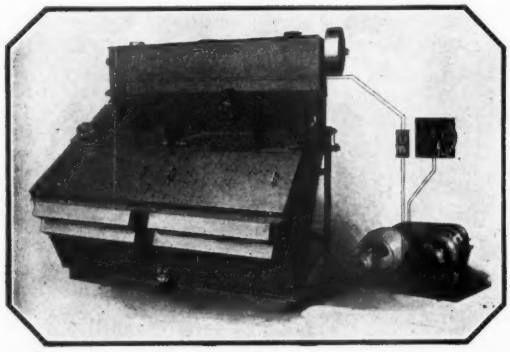
It will pay you to learn what the HUM-MER will do on your material.

THE W. S. TYLER COMPANY, *Cleveland, Ohio*

Manufacturers of **Woven Wire Screens and Screening Equipment**

A Few HUM-MER Users

American Coal Co.
Canada Portland Cement Co.
Britannia Mining & Smelting Co., Ltd.
American Smelting & Refining Co.
Duquesne Slag Co.
Highland Sand & Gravel Co.
Bethlehem Steel Company
The Bradford Brick & Tile Co.
Morris Fertilizer Co.
American Sugar Refining Co.

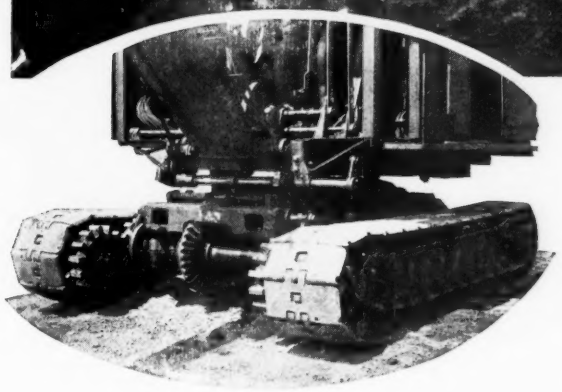


Type 31—Six-Foot HUM-MER *Electric* SCREEN

A Few HUM-MER Users

Ottawa Silica Co.
The Mesabi Iron Co.
Retsof Mining Co.
Diamond Alkali Co.
Solvay Process Co.
Rio Tinto Co., Ltd.
Goodyear Tire & Rubber Co.
Ford Motor Company
Pittsburgh Plate Glass Co.
The Proctor & Gamble Co.

AEROPLANE view of Model 21 Gasoline-Electric on rigid crawler trucks. The operator "maneuvered" as shown on the illustration without any assistance whatever.



Steers Entirely from the Cab

WHEN we say the rigid type crawlers on the New 21 are *steered altogether from the cab* we mean that we go just a step farther than the usual practice in power steering. Ours is a design in striking contrast with the construction of steam shovels that "steer from the cab" but whose *steering connections* must be operated *from the ground.*

On the New 21 the operator does not leave the cab nor need outside assistance *connecting and disconnecting chains, bars or clutches.* All that is necessary is to operate a handy lever inside the cab that enables the shovel to be steered in any direction.

For towing, a special device is used by which all clutches are disengaged permitting the crawlers to run free. If you would like to know more about how Marion Shovels are steered *entirely from the cab* ask us for copies of bulletins 228 and 305.

Check These Important Features Why the New 21 Steers Entirely From the Cab

1. The control lever inside of cab connecting with reach rods.

2. The reach rods connecting lower end of control lever with rock shafts at *both front* and *rear ends* of rotating frame.

3. The four arms on rock shafts that drop down in line with arms extending upward from lower frame and against which coil springs operate.

WITH THIS CONTROL THE NEW 21 CAN BE STEERED FROM INSIDE OF CAB IN ANY DIRECTION AND WITHOUT ANY OUTSIDE ASSISTANCE WHATEVER.

263

The Marion Steam Shovel Company

Marion Ohio.

Marion Crawler Trucks Make Hard Going Easy

Rock Products

Volume XXV | Chicago, October 7, 1922 | Number 20

Where the Excavator "Walks to Its Work"

In this recently completed gravel plant a "walking" dragline adds great flexibility. The plant produces 1500 tons a day with but six men

WHEN the new plant of the Service Sand and Gravel Co., at Rockford, Ill., was in course of construction, the natural elements of the deposit seemed to justify the installation of a flexible excavating unit, and one which could move about quickly and for loading the material from the storage

The field conveyor is 24 in. wide and 300 ft. long. Provision has been made which permits the lengthening of the conveyor when necessity demands. The portable feeder is designed to discharge in an even flow at the rate of 150 tons per hour to the belt. This feeder dispenses with one man's labor and the fluctuating loading of the belt and the spillage usually attendant upon hand feeding are eliminated. This 6-yd. hopper is equipped with a grizzly which permits stones to pass

The plant, showing the excavator, portable field hopper and on the right the field conveyor with drive end dumping into the main conveyor. Note that the excavator is close to the plant

accomplish with ease tasks which the average type of excavator is seldom called upon to attempt.

A "walking" dragline excavator of the Monighan type, equipped with a 50-ft. boom and a 1½-yd. bucket, was installed, as well as a field conveyor with portable hopper having a 30-in. apron feeder.

This excavator can walk in any direction by means of two pontoon shoes on either side of the machine which lift the machine and move it forward or backward as desired. The machine is thus enabled to move from one point to another in a comparatively short time and with no additional equipment. It is possible therefore to use the machine for handling fuel, stripping the overburden and digging and loading straight run-of-bank material into trucks for local delivery, besides loading directly into the field-conveyor hopper. The machine may also be equipped with a clamshell bucket

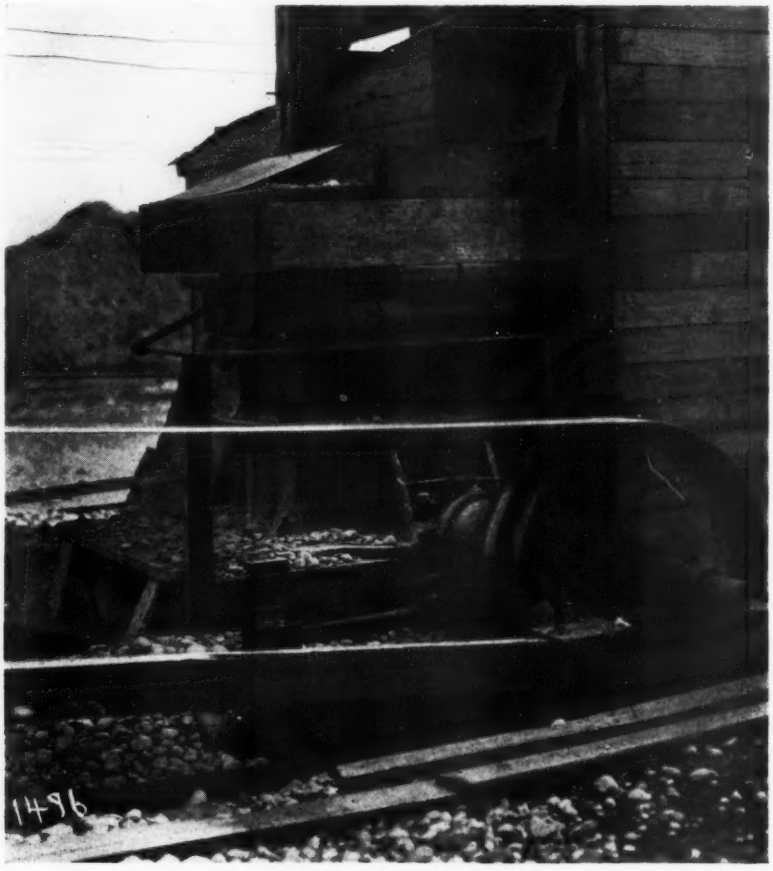
Charles A. Adams, engineer in charge of plant design and construction

through only under 7½ in. The grizzly is hinged on one side so that an accumulation can be readily dumped by hooking a chain to the excavator bucket. Mobility of the hopper is had by a set of double-flanged wheels on either side of the belt frame which run on light rails. The excavator moves either forward or backward. Control of the conveyor is effected by means of an automatic starting compensator which is operated by push-buttons located at the stations in the plant.

The field conveyor dumps on another conveyor which transports the material direct to the scalping screen where it is sized to 1½ and 2¼ in. Underneath the scalping screen, where its two sections are joined, a flop gate is so arranged that material passing through the 1½-in. screen is chuted direct into a 16-yd. bin. It is then ready for the sizing screens, while the material which passes through the 2¼-in. screen goes with the re-

Conveyor loading unit and "walking" machine in action. Note cam and pontoon shoe of excavator

Field and crusher conveyors discharging to the main conveyor



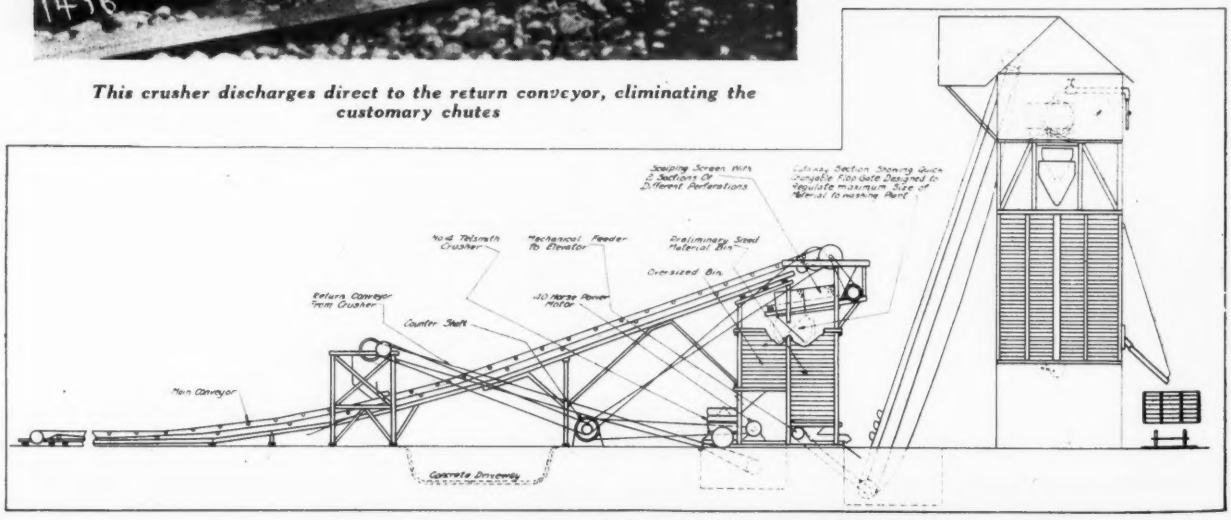
This crusher discharges direct to the return conveyor, eliminating the customary chutes

jections to a 5-yd. bin which serves the crusher. By flopping the gate, both sizes can be chuted to the bin serving the screens while only rejections go to the bin serving the crusher.

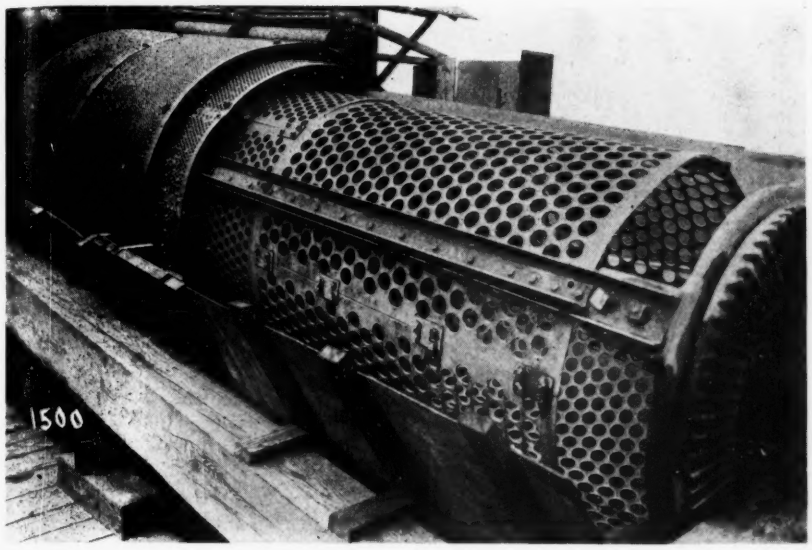
The crusher is a No. 4 Telsmith gyratory and can easily take care of all rejections. It then discharges to another 24-in. conveyor which in turn discharges to the main conveyor. Consequently, no material is elevated to the screening and washing plants except that passing through the desired perforation of the scalping screen.

An automatic feeder regulates the flow of sized stone into a bucket elevator to the screening and washing plant. The feeder is chain-driven from the elevator foot pulley and is operated by a friction clutch. The bucket elevator discharges to a catch box and the material is washed into the scrubber end of a triple-jacketed trunnion screen 18 ft. long and 48 in. in diameter, in which it is washed and sized. The materials are chuted direct from the screens to their respective bins.

Five bins of standard timber construction are mounted on concrete piers 12 ft. in height and placed crosswise of the plant, directly under the bin partitions, thus permitting trucks to drive under them and to be loaded with any grade of material desired. The railroad cars are loaded on the



Cross-sectional view of the plant's scalping screen arrangement



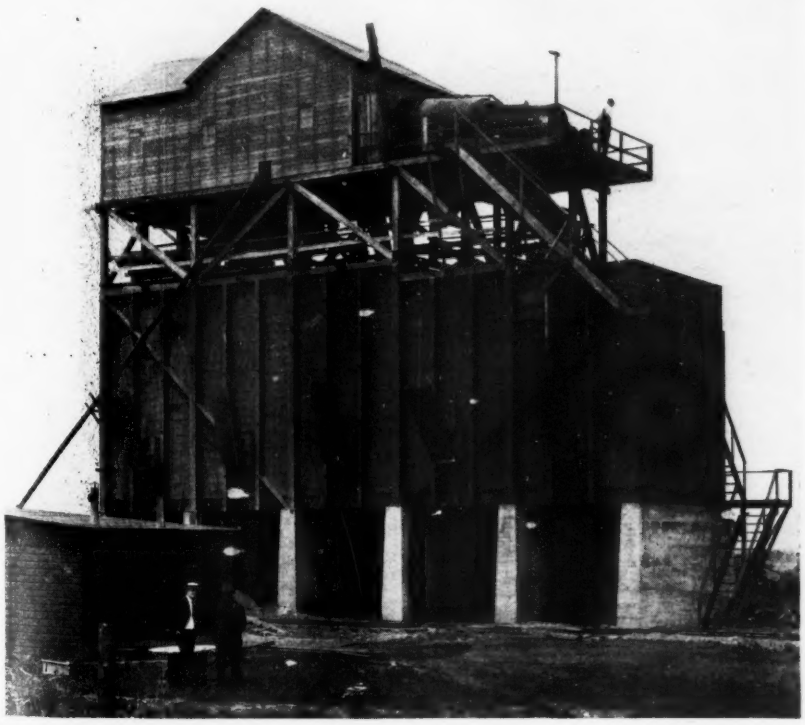
In this triple-jacketed screen the material receives a thorough washing and sizing

outside from chutes in the sides of the bins. The present trackage provides accommodation for 35 cars.

The plant, which is electrically operated, has a capacity of 1500 tons per 10-hr. day with a force of six men. The total connected load is 195 hp., including the excavator.

Swan Lindskold organized this corporation and is responsible for its promotion. He is also its general manager, with offices in the Swedish-American Bank building, Rockford, Ill.

Charles A. Adams was the engineer in charge of plant design and construction and supervised the purchase and erection of its equipment.



Trucks go directly under any one of the five bins, due to this method of erecting piers

The "Greased Pig" of Cost Accounting

A PRIME example of the effect of business policy upon costs is evident from the treatment of depreciation, writes Charles Wadsworth 3d in *Chemical and Metallurgical Engineering* for August 16. Depreciation represents the diminution in value which equipment or buildings undergo with use and time. Some accountants believe that depreciation should be figured at a definite percentage of the original value.

A machine costing $5000 if depreciated at 10 per cent per year would have values of $4500, $4000, $3500, etc., at each succeeding year. Others believe that depreciation should be modified to correspond with the replacement value of the equipment. For example, at the end of three years the cost of the $5000 machine is actually $6000. Ought not the amount to be written off be a definite percentage of $6000 instead of $5000?

"Remember, the theory behind depreciation is to set aside out of the profits a reserve for replacement of equipment. It has always seemed to me that the simplest method of figuring depreciation should be followed and the percentage set high enough so that there is a definite factor of safety in it. The same policy should be adopted in determining depreciation that is used in deciding about the installation of new types of equipment. In some industries—for example, cement—new equipment is installed if it can show a 20 per cent return on the investment. Therefore a conservative depreciation rate in that industry would be between 10 and 15 and a normal depreciation about 10 per cent.

"Many industries and firms are foolishly demanding and frequently miss extremely good investments on that account. They will not invest in changes of equipment unless the return amounts to 100 per cent in a year.

"Still another factor of depreciation is commonly called *Obsolescence.* It refers to the decrease in value of a machine due to the development of better manufacturing processes.

"There is yet another difficulty introduced into cost accounting by the necessity of meeting definite specifications. Some of the material may not come up to standard, in which case it may either have to be marketed at a loss, discarded completely or worked off in batches of standard material. The cost treatment obviously will vary with the method of disposing of the material. The treatment of waste, or spoilage as it is called, is most difficult when the material must be discarded. How shall the loss involved be treated? Shall it be accumulated in a special account and written off in small monthly increments, or charged off once a year to profit and loss? The former way is preferable.

Canadian Pulp Mill Operates Modern Lime-Burning Plant

By Joah Etchells
Of Richard K. Meade & Co., Baltimore

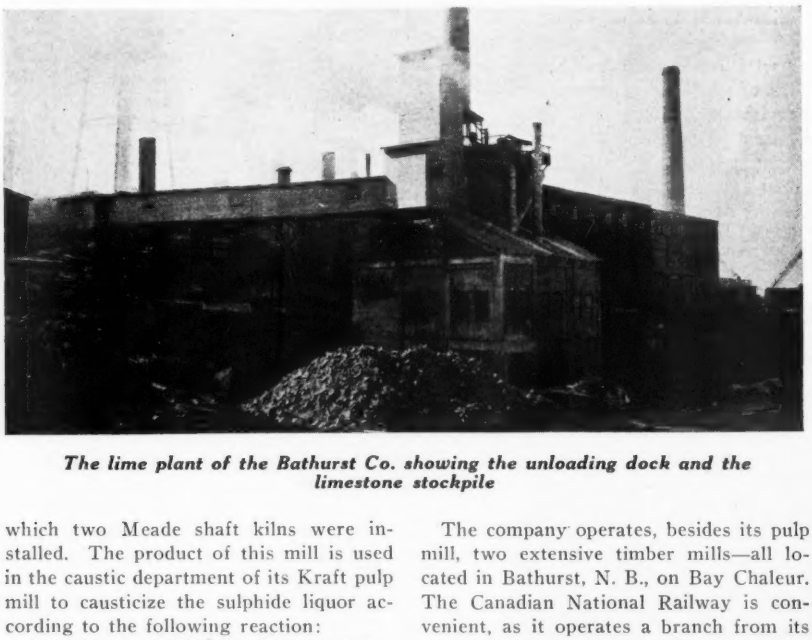
The Bathurst Co., Ltd., uses the product of this plant in the caustic department of its pulp mill. While the kilns were designed to burn coal, the cheapness and availability of this company's sawmill refuse, together with its present furnaces and equipment, have made wood a most satisfactory fuel. The entire construction was carried out by the Bathurst Co.

IN the fall of 1921 it was decided by the Bathurst Co., Ltd., of Bathurst, N. B., Canada, after much study and investigation, to erect a lime-burning plant, in which two Meade shaft kilns were installed. The product of this mill is used in the caustic department of its Kraft pulp mill to causticize the sulphide liquor according to the following reaction:

$$Na_2CO_3+Ca(OH)_2=2NaOH+CaCO_3$$

This caustic soda solution is mixed with sodium sulphide solution to form the "caustic liquor" with which the wood chips are digested at high pressure. It is reasonable to expect from this that a product as free from foreign materials, such as ash, and as high in calcium oxide as is possible to obtain is required, hence the choice of the Meade improved continuous flame type kilns.

In designing this plant the engineers spared no effort to make it the most modern and efficient of its size. In order to assure a constant supply of first quality lime, at low production cost, only proved efficient equipment was used. Later results have proved the efficacy of such methods and equipment.

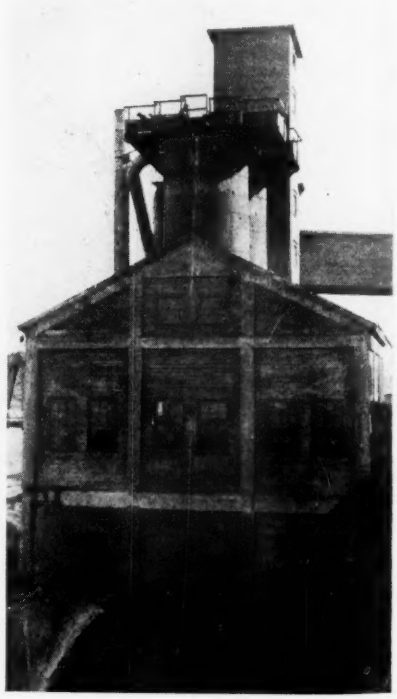


The lime plant of the Bathurst Co. showing the unloading dock and the limestone stockpile

The company operates, besides its pulp mill, two extensive timber mills—all located in Bathurst, N. B., on Bay Chaleur. The Canadian National Railway is convenient, as it operates a branch from its main line to the plant. The transportation facilities for finished and raw materials are of the best, though at present the pulp mill is using all the lime produced.

The limestone quarry is situated at Port Daniel, P. Q., 25 miles across the bay. The stone is high calcium, the analysis showing an average of 96 per cent calcium carbonate. The resulting lime is first-class for the process and equals that formerly shipped from Joliette, P. Q.

This company's quarrying methods are as usually found incident to lime-burning operations. All drilling is done with steam tripod drills and dynamite is used for blasting. The shattered rock is sledged to pieces from 6 to 8 in. in size and hand-loaded on skips and later picked up and dumped on barges with a derrick. The barges are towed across the bay by the company's tug to the dock close by the kilns. One of the illustrations shows the location of the pulp mill, the lime plant, the dock, the stock pile and the kilns. The cargo of stone is unloaded with a locomotive crane and tubs and a standard-gauge track parallels the dock. The tubs are hand-loaded, picked up by the crane



An end view of the lime plant

and then dumped on the stock pile. Sufficient stone can thus be stored to provide for continuous operation the year round. As navigation is closed on the bay during the winter months, sufficient stone storage must be provided to last through this season. The crane is also employed for other purposes around the plant.

The kiln building is at the dock level and in line with the caustic plant, this convenient location permitting efficient handling of raw and finished materials.

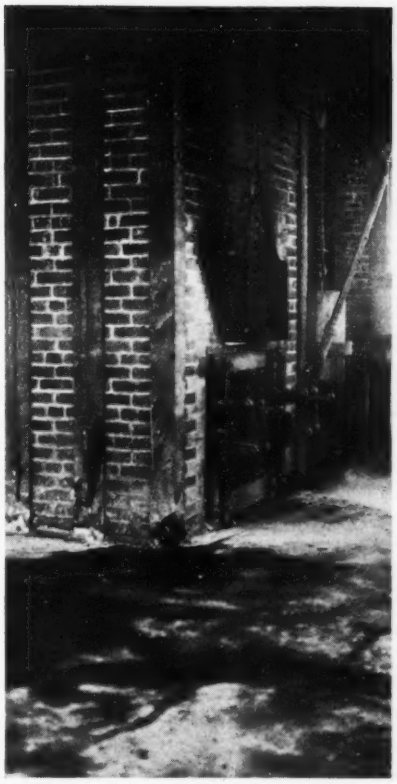
With the exception of the conveyor-bridge and the housing of the upper part of the elevator shaft, the building is constructed of reinforced concrete, with steel roof trusses. The frame structure is temporary and will be replaced with stucco and steel after building the contemplated new caustic plant.

Each of the kilns is provided with two external stoker-fired furnaces and induced draft. The capacity of one kiln is 15 tons of lime per 24 hours and under operating conditions this production has been confirmed. The foundations are reinforced concrete upon which are supported directly the steel shells, firebrick shaft linings, and cooling cones.

The kiln shafts are enclosed in steel shells of 11 ft. diameter and are 43 ft. high, constructed of boiler-plate bolted together in sections, each being provided with four poke-holes above the furnaces for punching the burden in case of a "hang-up."

The shafts are lined 35 ft. 6 in. high and inside are 7 ft. 6 in. diameter at the top; at the eyes they are drawn in to an elliptic cross section 5 ft. 6 in. x 7 ft. 6 in. with the minor axis along the center line of the furnaces. The shafts are lined to a height of 27 ft. with 18 in. of firebrick and 2½ in. of insulating brick, this portion thus lined being the burning zone. The balance of the shaft or preheating zone is lined with 9 in. of firebrick, omitting the insulating brick. Any space left between the firebrick and the steel shells is backed with red brick and an expansion filling of 1 in. of sand is also provided between all the brick work and the steel.

The two furnaces are on opposite sides of each kiln and are equipped with Huber hand-fired stokers. In their design are incorporated the best principles and latest knowledge of combustion engineering, in order to obtain proper calcining temperature, low fuel ratio, maximum output, minimum repair costs, and continuity of operation. An illustration gives a good idea of the external appearance of the furnaces and arrangement for operating stokers. The eye arches of the furnaces —the weak spots in most lime kilns—are of special design and consist of a heavy inside arch ring of 2 ft. radius and 15x18 in. cross section, constructed of seven



The furnaces and stokers

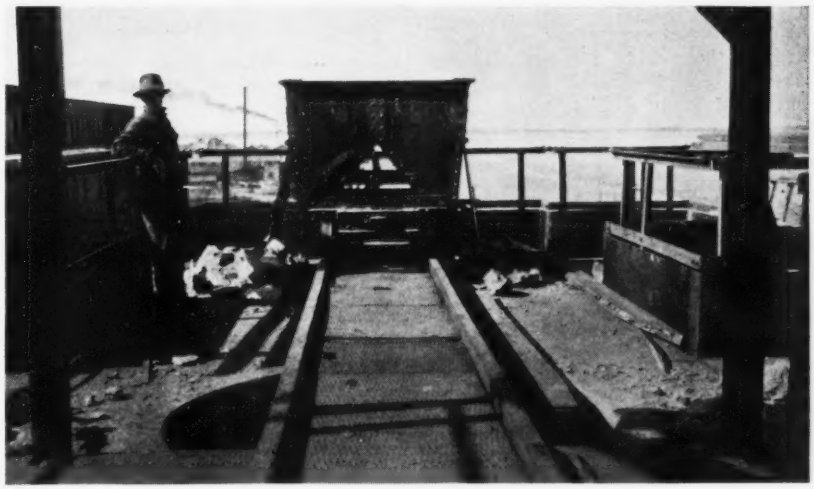
heavy first-quality firebrick blocks, keyed to the circle and relieved by a double arch of standard 9-in. side-wedge arch brick.

Stone storage hoppers—which are really the top unlined portion of the steel shells —are provided, having sufficient capacity to operate the kilns without replenishing during the night shift. Stone is discharged into the kilns through a cast-iron bell and hopper-charging device on each kiln. The charging hoppers with a limestone car discharging are shown in an accompanying illustration. The bell is counterweighted with a concrete counterweight and is very nearly balanced; the weight of the stone dumped into the hopper is sufficient to open the bell, while the counterweight has just enough in excess weight to effectively close the bell after the stone has dropped into the kiln.

The cooling cones are built of heavy boiler-plate and are provided with a water jacket at the top. Cold water, entering through a pipe connection at the top and discharging at the bottom through a slight overflow, continuously circulates around the cones. The results at other plants have confirmed the effectiveness of this design as an efficient cooling arrangement and no leakage in the jacket results.

Each drawing mechanism consists of two horizontal cast-iron shear gates. Each gate is supported by four rods hinged at the ends and operated by two link pins connected to two short lever arms keyed to a shaft. There are two shafts for each set of gates, arranged on opposite sides of the cone. The lower part of the cooling cone, with shear gates and operating levers, is shown in an illustration. Long handles are keyed and set-screwed to the shafts on the ends extending beyond the kiln foundation, and the operator, by pushing the handles apart, can separate the gates to any desired width of opening. These handles are outside the kiln base, so that the operator stands away from the dust from the fall of the lime into the car.

With this simple arrangement, a remarkably quick opening and closing period is obtained with a maximum area of discharge for large pumps. The lever action also gives the powerful mechanical advantage necessary to overcome the friction and weight of the lime in operating



The charging hopper and a car discharging its load

the gates, so that they discharge and close quickly without jamming. In the front of each cone is a poke-hole for punching the lime in case it refuses to follow down.

Draft is obtained for both kilns with a Sturtevant steel-plote exhauster, belt driven by a 10-hp. slip-ring, variable-speed motor. The fan and motor are mounted on a steel platform supported on the lower chords of the roof trusses and are accessible for inspection and oiling by means of the elevator to be described further on. The fan is connected to the top of each kiln through separate 20-in. diameter steel flues and discharges to the atmosphere through a 27-in. diameter steel stack. The flues are provided with sliding steel-plate dampers for regulating the draft according to the individual requirements of each kiln. The control of the intensity of draft is also obtained by the use of the variable-speed motor.

The charging platform is of steel construction throughout and is supported directly on top of the kilns. The tracks for the limestone cars consist of 10-in. channels and are a part of the supporting frame; they are directly over the center of the kilns.

Limestone is raised to the top of the kilns by means of a two-ton Otis-Fensom electric elevator operated by a 10-hp. slip-ring induction motor. The elevator cage and shaft are of steel construction. The equipment includes all the latest devices for safety and efficient operation. Automatic stops are arranged at the drawing floor and charging platform and the cage will stop exactly at the desired level so that the cars run on and off without having to juggle for position to bring the level of the two tracks coincident.

A reinforced concrete coal bin is located on the side of the kiln building nearest the caustic plant: it will hold the contents of a 50-ton capacity car. The bottom of the bin is hoppered and is level with the firing floor of the kilns. The coal feeds by gravity through two gates in the wall of the kiln building at the floor level, where it can conveniently be reached by the fireman. Coal is unloaded from the cars directly into the bin with a locomotive crane available at the plant. A 20-in. belt conveyor takes the lime from the kiln building to the storage bin in the caustic plant. This conveyor is housed in a frame bridge connecting the two buildings. At the feed end a loading hopper is located over the belt and a chute is arranged from this to the elevator shaft. The storage bin in the caustic plant is of timber construction lined with sheet-iron and designed to hold 50 tons of lump lime.

In brief, these are the principal details of the plant operation: The rock is loaded by hand into two-ton capacity gable bottom cars from the stock pile and pushed on the elevator in the kiln building at the level of the drawing floor. The cars are raised to the charging platform and their contents emptied into the charging hoppers of the kilns. One man can operate the cars and keep both kilns filled. The lime is handled in end-dump skip cars

Lower part of the cooling cone, showing the shear gates and operating levers

which run on a track underneath the center of the kilns. The kilns discharge directly into the skips, as no sorting at this plant is necessary. The skips are then pushed on the elevator by hand and raised to the level of the chute to the belt conveyor feed hopper and emptied. The feed hopper will hold the contents of a skip of lime and from this it is fed on the belt conveyor and carried to the storage bin in the caustic plant. The kilns are drawn every three to four hours by the follow-up method.

The kilns were designed to burn coal fuel, but owing to the cheapness and availability of sawmill refuse the Bathurst Co. has been using the latter fuel, and results have proved that the present furnaces and equipment are entirely satisfactory for burning wood. Three men are employed on the day shift to fire, trim coal, draw lime, and charge the kilns. The night shift requires two men—the extra man for reasons of safety to clean up the plant and do odd repair jobs when necessary.

The plant was designed and put in operation by Richard K. Meade & Co., 11 East Fayette street, Baltimore, Md. The construction was carried out by the Bathurst Co., which maintains a permanent construction organization at its mills.

Reheating of Compressed Air

FOR many years compressed air has been employed as a medium for the transmission of power, says Bulletin 130, prepared by C. R. Richards and J. N. Vedder for the Experiment Station of the University of Illinois.

The ease and economy with which compressed air may be transmitted for comparatively long distances through pipe lines, and the variety of air motors and tools now available, have led to the extensive use of compressed air in mining, quarrying and tunneling in various shop processes and in power development.

In the smaller air motors, air-driven tools, and devices operated by compressed air that are run intermittently, the air is not, as a rule, used expansively, economy of operation being sacrificed for simplicity and minimum initial cost of equipment. When motors are operated continuously for considerable periods of time, economy of operation becomes a factor, and it is essential that the air be expanded in the motor. The temperature of the air as it reaches the motor would normally be little if any above atmospheric; consequently, in accordance with well-known principles, after expansion it would be so low as to cause serious operating difficulties resulting both from the freezing of the moisture in the air and the consequent accumulation of ice in the exhaust pipe, and from interference with cylinder lubrication and resultant loss of efficiency.

These difficulties may be overcome by heating the air before its delivery to the motor to an initial temperature such that the exhaust temperature will be above the freezing point of water, this heating process being commonly designated as "reheating." Reheating not only reduces operating difficulties, but also affords a means of increasing the total output of power per pound of air by the expenditure of a small amount of heat energy.

The investigation leading to the publication of Bulletin 130 was undertaken to determine the ideal thermodynamic efficiencies resulting from the heat expended in the reheating process, the efficiency of external and internal combustion reheaters and the performance of an engine operated with air used expansively, with steam alone, and with a mixture of air and steam, the steam being injected into the air pipe as a means of reheating the air. Copies of this bulletin may be had without charge by addressing the Engineering Experiment Station, Urbana, Ill.

Steam Helps Lime Burning

Results of experiments to determine the best catalyst for increasing the rate of calcination

FROM time immemorial limestone has been burned by more or less the same process. The mere heating of a piece of limestone for a few hours to a bright red heat is sufficient to cause calcination.

The real fact is, however, that the lime industry is founded upon chemical processes or reactions, and that although a partial success can be gotten in this industry with very little knowledge or experience, the attainment of economy or high-grade efficiency demands skill and intelligence of high order, which cannot be reached without the use of technical methods and scientific training. The manufacture of quick-lime is now undergoing a rapid transformation from the old crude, vertical type kiln, in which the burner sold the product of his own kiln, into a large, finely equipped business in which every detail is adjusted to minimum waste and maximum output.

The larger and better lime manufacturer no longer thinks that he knows everything worth knowing about the production of lime. He is in search of all reliable information and ready to make improvements wherever there is a reasonable chance of such changes producing greater economy. He is now beginning to feel that the use of technical methods and scientific training can probably do as much in the advancement of the lime industry as they have in the case of other large industries.

There are three factors essential to the process of lime burning: (1) The stone must be heated to the temperature of dissociation of the carbonates; (2) this temperature must be maintained for a certain length of time; (3) the carbon dioxide evolved must be removed.

A certain quantity of fuel must be supplied to dissociate the carbonates in the stone. The quantity varies with the chemical and physical properties of the stone. In supplying this fuel, it is optional to use either a high temperature for a short time or a lower temperature for a long time. The temperature used must be higher than 898 deg. C., if the decomposition is to take place at atmospheric pressure. The more nearly the amount of fuel used approaches the minimum required the better will be the quality of the lime.

Lime occurs in nature chiefly as calcium carbonate, from the almost chemically pure form of calcite and aragonite, in various degrees of purity, down to the loamy and impure marl clay.

When exposed to higher temperatures the calcium carbonate is decomposed according to the reaction:

$$CaCO_3 + \text{heat} \rightarrow CaO + CO_2$$

This reaction requires 1451 B.t.u. per lb. of lime.

Limestone occurs in another form as dolomite, the double carbonate of calcium and magnesium. Its percentage composition when pure is 54.35 per cent calcium carbonate and 45.65 per cent magnesium carbonate. Commercial limes may contain anywhere from 0 to 44 per cent of magnesium oxide in addition to small amounts of impurities, such as iron, aluminum, and silica oxides.

LABORATORY experiment is one thing and plant operation another. Methods which work beautifully in the laboratory often fail utterly under practical operating conditions. Nevertheless laboratory experiment can nearly always precede to advantage the more expensive experimentation in the plant with new methods, and properly conducted laboratory work usually results in valuable information. The tests described here in the use of catalysts in lime burning, conducted by Herbert P. Bailey of the University of Cincinnati, give some positive results, and Mr. Bailey shows how to figure the comparative costs of lime with and without the use of steam. Mr. Bailey acknowledges the assistance of Dr. R. S. Tour and Prof. G. C. Smith of the chemical engineering faculty of the university, and of W. Moores of the Moores Lime Co., Springfield, Ohio.

Like limestone, it is subject to the same variations in compositon and physical properties, as we have hard, compact dolomites, as well as soft, marl-like dolomitic materials. When exposed to higher temperatures the magnesium carbonate is decomposed according to the reaction:

$$MgCO_3 + \text{heat} \rightarrow MgO + CO_2$$

This reaction requires 1318 B.t.u. per lb. of lime.

Kinds of Limestone

Limestones have been divided into four classifications by the American Society of Testing Materials, as follows:

Classification	Calcium Oxide Not less than	Calcium Oxide Not more than	Mag. Oxide Not less than	Mag. Oxide Not more than
Calcium	85%	90%	.....	.....
High Calcium	90%	.....	.....	.....
Magnesium	.....	.....	10%	25%
High Magnesium	.....	.....	25%	.....

The kilns for burning limestone consist essentially of shafts lined with fire brick. The limestone is fed in at the top and the lime drawn out at the bottom. Under ordinary conditions, calcium carbonate will break up at 898 deg. C., or 1648 deg. F. There are many varieties of fuel used in burning.

It is unlikely that incandescent calcium carbonate would react the same in an atmosphere of nitrogen as in an atmosphere of carbon dioxide or in the presence of some other chemical reagent. Which reagents accelerate and which retard the calcination of the stone? Will the use of steam possibly aid calcination or will the use of any inert gas possibly aid calcination?

It has already been proven that the impurities contained in limestone accelerate the rate of decomposition, this being especially true of silica. At 1000 deg. C., 8 per cent of silica causes the lime to be overburnt owing to the formation of a calcium silicate. The higher the temperature the greater will be the effect of any silica present. The same thing has been proven of alumina and iron, though these are less energetic in their behavior. However, from a practical standpoint, the presence of silica, iron and alumina cause the lime to be of an inferior quality. For this reason, these elements will not be considered in the present investigation.

In order to carry out a complete investigation on this subject, preliminary work was carried on by using various chemical reagents as catalysts in the burning. Then a further investigation was made using one of the experimental reagents. The following table gives the preliminary results:

Time hours	Wt. of sample grams	Temperature deg. F.	Grams lost	Catalyst
3	100	1500	45.40	None
3	100	1510	45.50	None
3	100	1530	45.64	Water 1 gr.
3	100	1530	48.20	Water 5 gr.
3	100	1470	39.60	Sodium chloride 5 gr.
3	100	1530	44.50	Charcoal 2 gr.
2	100	1430	42.00	None
2	100	1500	44.00	Water 6 gr.
2	100	1520	45.10	Water 10 gr.
2	100	1470	40.80	Manganese dioxide
1	100	1440	23.70	None
1	100	1370	20.64	Sodium chloride

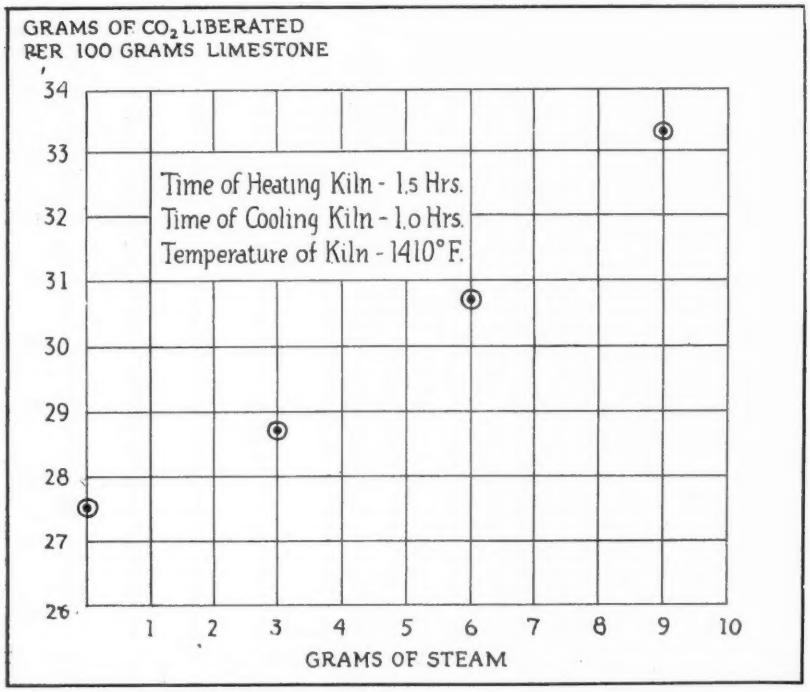
A limestone analyzing 56.5 per cent $CaCO_3$, 42.5 per cent $MgCO_3$, and 1 per cent impurities, was crushed to a uniform mesh, size ⅛ in. The stone was dried and placed in

desicators. The moisture content was 1 per cent. In preparing for an experimental run, an alundum tube ⅞ in. inside diameter and 30 in. long was carefully weighed, the limestone placed in the tube and the total again weighed. If a catalyst were used in the experiment, as for example sodium chloride, the material was carefully weighed on an analytical balance and distributed uniformly throughout the limestone. If a liquid were used as a catalyst the substance was introduced as a vapor after the heat had been applied for a period of 30 min. The tube now loaded was placed in an electric resistance furnace. The time for applying heat was definite for each run, and the voltage and amperes were constant. The temperature taken by means of a pyrometer was observed at the end of each run.

For a two-hour experiment the current was applied for exactly two hours and the tube and its contents were removed from the furnace and allowed to cool for a period of one hour. The length of time for cooling was constant for all runs. After cooling, the calcinized limestone was weighed and the loss of carbon dioxide recorded.

In order to arrive at some definite conclusion from these experiments, the investigation was carried out more completely, using steam as a variable. All other conditions in the experiment were constant. Thus, the length of time for each run was one and one-half hours, the time for cooling the tube and calcined limestone before weighing was one hour, the temperature of the furnace for each run was raised uniformly from 75 deg. F. to 1410 deg. F. in the first 30 min. time of the run; for the last 60 min. of the experiment the temperature was constant, 1410 deg. F. Steam was introduced into the alundun tube at the end of the first 30 min. and the weight of limestone was the same for each run. Following the heating and cooling, the calcined stone was weighed and the loss of carbon dioxide recorded.

Two tests were made for each quantity of steam used, and the average of the two tests with 0, 3, 6, and 9 grams of steam has been platted in the accompanying curve. In no instance did either of the two tests vary as much as ½ of 1 per cent from the average of the two. The increase in CO_2 produced by the use of larger quantities of steam is an indication of its value as a catalytic agent in lime burning.



Will It Pay to Use Steam?

To show whether the use of steam in lime kilns results in a gain or loss, the calculations below are given. The figures used are assumed plant conditions.

	Pct.
Percentage of CO_2 liberated under ordinary conditions	27.5
Percentage of CO_2 liberated when 6.0 grams of steam was used per 100 grams of limestone	30.7
Difference	3.2

Assume the following figures for plant operation:

$2.00 cost of limestone per ton of lime.
2.20 cost of fuel, labor, repair, etc., per ton of lime.

$4.20 cost of burning lime per ton.
3.00 interest, depreciation, office and general expense per ton of lime.

$7.20 total cost of lime per ton.

Cost, for making steam, and miscellaneous charges. Assume the following conditions:

14.3 tons of coal required to produce 50 tons of lime from 100 tons of limestone.

B.t.u. value of the coal per pound	14,000
Temperature of the kiln	1410 deg. F.
Temperature of the steam	212 deg. F.
Amount of steam used	6 tons
Cost of the coal per ton	$3.50

$1410 - 212 = 1198$

$$\frac{1198 \times 6 \times 2000 \times 0.40}{14{,}000 \times 2000} = 0.205 \text{ tons of coal required to heat steam from 212 to 1410 deg. F.}$$

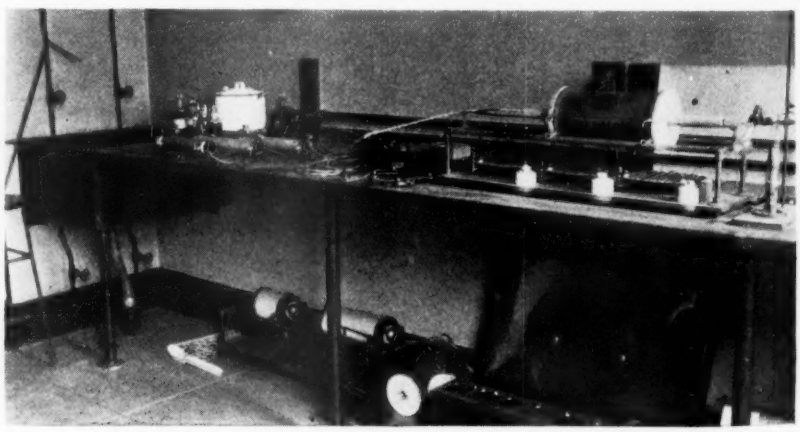
In practice, 8 lb. of steam per pound of coal is a fair condition to assume.

$$\frac{6 \times 2000}{8} = 1500 \text{ lb. or } 0.75 \text{ ton of coal required to make steam.}$$

0.205 tons
0.75 tons
0.955 tons total coal required.

$$\frac{0.955 \times \$3.50 \text{ cost of coal per ton}}{50 \text{ tons lime yield}} = \$0.0668 \text{ cost of steam per ton of lime.}$$

$0.0668 cost of steam, per ton of lime.
0.01 cost of labor, maintenance, etc., on steam pipes.



Laboratory equipment for conducting tests in catalysts of lime burning

$0.0768 total additional cost per ton of lime when steam is used in the kiln.
100 + 3.2% (difference) = 103.2% for conditions when steam is used.
$3.00 expenditures for ordinary conditions per ton of lime (without the use of steam).
$3.00 ÷ 103.2% = $2.907 expenditures per ton of lime when steam is used.

Therefore, the total cost to manufacture a ton of lime with steam is as follows:

$2.9069 expenditures per ton of lime.
.0768 cost of steam per ton of lime.
4.20 cost of fuel per ton of lime.

$7.1837 total cost per ton of lime with the use of steam.

Cost to manufacture lime without steam:

$3.00 expenditures per ton of lime.
4.20 cost of fuel per ton of lime.

$7.20 total cost per ton of lime without the use of steam.

Gain per ton of lime:

$7.2000
7.1837

$0.016 or 1.6c gain per ton of lime under the above conditions.

A possible explanation for the fact that with an increase of steam there is an increase in the rate of calcination may be based on the fact that the addition of steam tends to lessen the partial pressure.

It is well known that the chemical reaction involved in burning lime is reversible.

$$CaCO_3 \rightleftarrows CaO + CO_2$$

The factor which determines the way the reaction shall go is the pressure of carbon dioxide. If this gas is removed as formed so that its partial pressure is kept below that given for the temperature by Johnston's equation, the reaction will continue in the direction to form lime. But if the gas is allowed to accumulate until its pressure becomes higher than this, the reaction will be reversed and will give rise to the phenomenon known technically as "recarbonizing." Therefore the prompt removal of the gas is an essential operation in lime-burning.

In addition, the writer feels safe to mention at this point that any inert gas, for example, air, would give the same results as revealed by the use of steam. In other words, by injecting air into a kiln, it would tend to lessen the partial pressure and in turn cause an increase of the rate of calcination. However, steam is used to a good advantage in kilns for mechanical purposes, hence its service is two-fold, mechanical and physical. The use of air in lime kilns from a mechanical point of view has not as yet proven satisfactory.*

From the table on cost, the writer has shown that a net gain of 1.6 cents on every ton of lime is possible using a ratio of 6 tons of steam for every 100 tons of limestone. Hence from a practical standpoint, it would be profitable to use steam in lime kilns and also a means of obtaining the maximum capacity of the kiln.

It is very likely that calcium carbonate undergoes many chemical changes during the process of burning. This would be especially true in the presence of a catalyst.

From the curve, we learn that with an increase of the catalytic substance (steam) there is an increase of carbon dioxide evolved. This might be explained by means of the following equations:

$$CaCO_3 + H_2O \rightarrow Ca(OH)_2 + CO_2$$
$$Ca(OH)_2 \rightarrow CaO + H_2O$$

*Eldred Process in lime kilns.

Summarizing the gain or loss when steam is used in lime kilns under the conditions of this experimental work.

Tons of steam per 100 tons of limestone	0.0	3.0	6.0	9.0
Gain per ton of lime	....	....	1.6c	5.6c
Loss per ton of lime	....	1.0c	....	....

In summarizing this investigation, the writer desires to point out that any lime manufacturer can estimate whether the use of steam in lime kilns is practical or impractical. In other words, the superintendent of a lime plant can substitute his table of cost together with the data given in this investigation and calculate the gain or loss that would result by using steam in the kilns for his particular plant.

From the conditions assumed for the imaginary lime plant, it has been shown that by using 3 tons of steam per 100 tons of limestone there is a loss financially. By using 6 tons of steam per 100 tons of limestone, under the same conditions, a gain of 1.6 cents per ton of lime is noted. For 9 tons of steam per 100 tons of limestone there is a greater gain. Hence, under the conditions assumed for the imaginary lime, it has been proven that by using 3 tons of steam per 100 tons of limestone the plant would be operated at a loss. On the other hand, by using 6 or more tons of steam per 100 tons of limestone, the plant would be operated under favorable conditions and a gain would be credited.

From a physical and chemical, as well as a practical standpoint, steam has been proven to be an excellent reagent to use in lime kilns, in order to obtain the maximum rate of calcination and in turn obtain the maximum production and a lime of superior quality.

Intelligent Control in the Lime Industry

CONTROL—intelligent control—is undoubtedly the answer to the question, "What can the lime industry do to increase its production efficiency?" writes Warren E. Emley of the Bureau of Standards in *Chemical and Metallurgical Engineering.*

Ten years ago there were few limekilns making more than 3 lb. of lime per pound of coal. Today there are few making less than 5. Fuel efficiency doubled in 10 years! This is an achievement of which any industry might just be proud.

This was accomplished because competent engineers made a careful study of kiln design, fuel combustion, heat distribution and temperature control. The facts which were discovered were put into practice. Pyrometers and chemists have come to be important factors in the operation of a lime plant.

While congratulations are in order, one should remember that the fuel ratio theoretically possible is about 14 lb. of lime per pound of coal, so that there is still room for further improvement. However, fuel efficiency is only one item of production efficiency.

Years ago one used to hear statements like this: "The stone in my quarry is not so pure as that of my neighbor. I can't make as good lime as he can, but it is not my fault." The modern version of this story shows a radically different viewpoint: "My neighbor makes a good building lime, but he is getting only $6 a ton for it and he can operate only eight months a year. My stone will not make good building lime, but it is much better than his for making bleach. I will sell it for that purpose, where they pay $9 a ton and the demand is steady throughout the year."

The modern lime manufacturer has discovered the fact that no lime can be called good or bad unless its use is considered. A lime which is excellent for one purpose may be unfit to use for some other. For this reason it is necessary for the lime manufacturer to study the way in which his lime is used. It is only through a thorough knowledge of his customers' requirements that he will be able to make the best lime to meet those requirements.

The old idea was to make the "best" possible lime from the stone available, the definition of the word "best" being based on the opinion of the lime manufacturer. This lime was then sold for a variety of purposes, for only a few of which it was suitable. The modern idea is to let the customer define the word "best"; to study his individual needs, and change the process of manufacture in such a way as to produce the kind of lime best suited to meet those needs. This, of course, involves accurate and continuous control not only of the manufacturing process but also of the sales organization, to see that each particular kind of lime is used only for the purpose for which it is best adapted.

Intelligent control includes not only the control over the manufacturing process and of the sales but a far more important idea: the lime manufacturer must control his opinion of the quality of his lime, and make it subservient to the opinions of his customers.

Quebec Spending Road Money

THE province of Quebec is spending $7,500,000 upon provincial roads. Previous to 1912 it spent $40,000,000, and since that time $30,000,000. The federal government is granting aid to the extent of $20,000,000, and has authorized the construction of 5125 miles of roads.

Better Results from Wire Rope

By E. O. Keator
Civil Engineer, Dayton, Ohio

Too many accidental breaks occur from too little thorough knowledge of wire ropes, their strengths, and proper methods of fastening. This article, presented at the recent National Safety Congress, is full of valuable practical hints for the safe use of wire rope

WIRE rope is in itself the most reliable of all structural materials, but it is also a complex material and cannot be used to advantage in the rough and ready manner that other structural materials are used. It is necessary to follow certain definite rules to obtain satisfactory results and, when those rules are ignorantly or otherwise disregarded, disaster often follows.

The purpose of this article is to point out a few details where better co-operation between the manufacturers and users of wire rope will result in the elimination of certain classes of accidents, and to promote a better understanding between the two parties. A brief survey of the history of wire rope will aid us in getting started on the right track.

There is no authentic record showing that iron or steel rope was used prior to the advent of the steam engine, in the early part of the last century; in any event, the steam engine created the demand for strong hoisting lines capable of lifting the heavy loads that man was enabled to handle with this new and powerful agency. Wire hoisting rope was first used in mines, but its great strength, comparative lightness and adaptability led to its gradual extension to all fields of human endeavor where the lifting of heavy loads was a part thereof. We have today the mine hoist, the elevator, the conveyor, the derrick, the pile-driver, the electric hoist, the well drill, the oil pump, the steam shovel, the log carrier, the crane, the dredge, the ditcher and many other types of load-handling machinery, all operated with wire rope. Being a complex material, yet widely used and almost as dangerous as dynamite when not used intelligently, it would be quite appropriate to insure intelligent use of this excellent material in the many fields it has invaded.

Why Steel Ropes Are Better

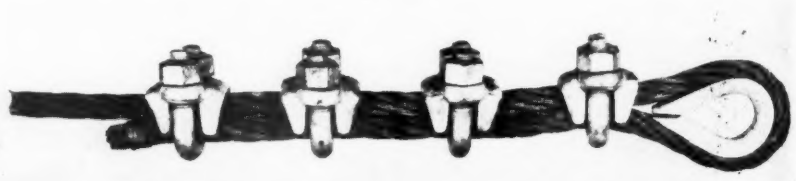
For more than 50 years, or until the advent of the openhearth and bessemer processes of manufacturing steel cheaply, all cables were made of iron having tensile strength of from 50,000 to 60,000 lbs. per square inch, and it should be borne in mind that the ordinary types of wire rope fastenings in use today, viz., the clip, the three-bolt clamp and the loaded-in-socket, were evolved in those early days for use with those low-strength iron cables.

As men began to learn the superiority of steel ropes over iron ropes, the former came into the more general use, but it never has entirely superseded the iron rope and there are many men, even today, in responsible charge of hoisting machinery, who believe that Swedish iron rope is the strongest and best grade of rope made. This belief is erroneous, of course, but it exists to a considerable degree and shows a fundamental ignorance on the part of many users which, taken with other conditions in a like state, points to the need for better co-operation between the manufacturer and user. There are six commercial grades of wire rope, of which iron having a tensile strength of approximately 60,000 lb. per square inch, is the weakest; next comes mild steel at 85,000; crucible cast steel at 160,000 to 200,000; extra strong crucible cast steel at 190,000 to 220,000; plow steel at 200,000 to 260,000; and improved plow steel at 220,000 to 280,000 lb. per square inch.

Hard To Tell Apart

With this fine array of material one would suppose it to be a simple matter for any one knowing of the existence of the several grades to select that which was best suited to his purpose. Such, however, is not the case because all the grades look exactly alike and there is no way for the ordinary user to tell the difference between them; he might need a plow steel cable but be furnished at the supply-house with an iron cable with but one-fifth the working capacity of the plow steel cable.

Let us consider a hypothetical case of this kind: Suppose a steel-frame building is under erection in the downtown section of one of our big cities. High above the street, over the heads of hundreds of people passing to and fro, is a derrick, hoisting from a truck in the street the steel beams, girders and columns that compose the frame of the building. A state inspector comes along and in the course of his duties examines the hoisting rope being used to place the steel members just mentioned. He decides, correctly, too, that the rope already has worn beyond the safe stage and that no more hoisting may be done with it. Work stops. The superintendent hurries to the telephone and issues a rush order for a new hoisting rope.



The correct position and number of this well-known forged-steel clip for fastening 5/8-in. plow-steel cable is four clips, spaced at six diameters of the cable, with U-bolts all in contact with the short end. If applied neither too loose nor too tight, and kept that way by daily inspection, they give an efficiency of from 75 to 80 per cent, or approximately 20 per cent per clip. Larger cables require more clips than this; smaller cables, fewer

The old rope is removed and the new one put in as quickly as possible, but an hour has been lost where every second is valuable. The instant all is ready the superintendent orders the hoisting engineer to "tear in," which he proceeds to do. He picks up the load, opens the throttle wide and away sails the load. A hundred feet from the ground and there is a cry aloft from the signalman, "Look out below!" The new cable has parted and dropped the

load upon a group of passers-by. The coroner makes his investigation and reports that "Deaths were unavoidable, due to faulty hoisting cable. Cable, although new, weaker than old one." But the coroner was wrong in his finding; the cable was not faulty; the trouble was that a new iron cable had been substituted for a plow steel cable, and, neither being marked in any way to identify them or ascertain their relative strengths, the hoisting engineer naturally thought the new one was at least as strong as the old one.

When common malleable clip and a pressed steel clip have been removed the destructive action of the U-bolt of the malleable clip and of both U-bolt and base of the pressed steel clip are clearly shown. It is not difficult to damage a cable in this manner with clips ¾-in. and under; and the cable is weakened thereby sometimes as much as 40 to 50 per cent by a single clip

Accidents of this kind, but fortunately without serious results as a rule, are common on construction work, as every experienced construction man knows. An examination of the broken cable proves nothing to the man on the job. All he knows is that the new cable was not as strong as the old one, but he learns nothing of value that will prevent a repetition of the disaster. He might go to another supply-house to buy the cable, but it is just as likely to be iron cable as it was before. This situation confronts every hoisting engineer on construction jobs, in industrial plants and in mines, although in the latter many safeguards are required that are not found elsewhere.

To eliminate all guesswork in connection with the choosing of wire rope to perform certain work, the wire rope manufacturers should be required to mark all cables, or at least all hoisting cables, at the time of their manufacture; giving the name and address of the manufacturer, the grade of steel of which the cable is made, its rated tensile strength (new), the working load and minimum diameter of drum on which it can be safely used.

Why Cables Should Be Marked

The plan of marking cables has a number of advantages: 1. It is an important safety measure. 2. It eliminates chances for fraud and insures the customer that he gets what he pays for. 3. By no means the least important, it furnishes the hoisting engineer and other interested parties a firm foundation upon which to build a knowledge of wire rope. A long step is made in this knowledge by any one who secures certified samples of the various grades, all in one size, and, by bending back and forth with the fingers, compares the stiffness of wires of the various grades, remembering that "the stiffer the wire the stronger the cable." Practice in this, along with frequent reference to the printed tape, giving the actual strength of the cables, would soon make the hoisting engineer something of an expert who, by applying the "finger-bend-test," would not miss the grade of cable much, even though it were unmarked.

After a cable has been intelligently selected the next step is to attach it safely and securely, so that it will perform the work expected of it without danger of coming loose. To do this properly is one of the most difficult feats to perform in the entire construction field and it is safe to say that, with methods in common use, no one can do it who has not had abundant laboratory-testing experience or works under the supervision of some one who has had. In no other way will the pitfalls that beset the workman be recognized and avoided. For instance: Instructions by the wire rope manufacturers in the matter of applying clips call for wrenches of various lengths to be used with clips of specified sizes, and a specified maximum pull on the wrench when tightening the nuts on the U-bolts. The pull on the wrench handle in pounds, multiplied by the length of the wrench from the center of pull to the center of the bolt, is called the torque. When the torque exceeds a certain amount specified for any particular manufacturer's clip—which is usually far below the figure necessary to strip the threads or rupture the bolt—the U-bolt has cut into the cable and damaged it, thus weakening it. On the other hand, if a smaller torque is used the efficiency and effectiveness of the clip is impaired, thus the close relation between theory and practice is demonstrated.

This ⅞-in. cable was part of a guy line of a large steel derrick. As the mast being raised reached an angle of 30 deg. with the ground, this line parted under one of the clips and dropped the mast, wrecking it. The cable was new and had been figured to be more than sufficiently strong to take the load of raising the mast, but the riggers over-tightened the clips, with disastrous results

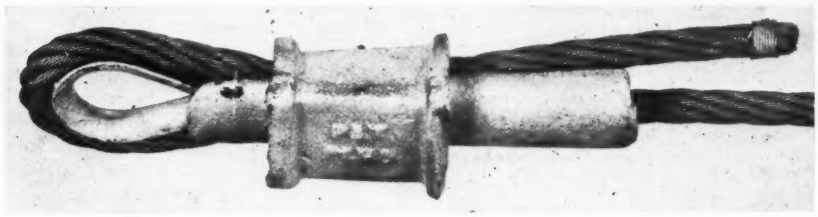
Wire ropes today are rarely fastened by experts or by persons who have made laboratory tests, and the frequency with which we hear of fastenings failing under ordinary working loads testifies to an abundance of fastenings having efficiencies around 25 per cent and lower. In recent tests it has been found that babbitted sockets, prepared in the most approved manner, failed under loads as low as 25 per cent of strength of the cable. Inspection, by the writer, of a large number of fastenings in use that had not failed, as compared with similar test specimens, duplicating them as near as possible, forced the startling conclusion that the average efficiency of cable fastenings made on construction work and in the industrial plant is well under 50 per cent, and that the reason there are not even more accidents than now occur is due to the fact that working loads have been exceeded very little, if any. This certainly is not safe practice in the use of wire rope.

The minimum allowable efficiency of wire rope fastenings, compared with the tensile strength of the cable, new, depends upon the nature of the work performed. Ropes that take static loads only, such as suspension bridges, should have 100 per cent fastenings. Hoisting ropes wear out where they run over drums and sheaves. The efficiency of hoisting-rope-fastenings then, need be no greater when the ropes are new than the ratio of the tensile strength of the worn section to the tensile strength of the cable when new. Thus, hoisting cables are used until worn to 65 per cent of their original strength and then discarded. Fastenings, therefore, having an efficiency of 65 per cent or over have, for

The cam-clip shown here is, like the wedge-socket, a self-tightening clamp. After being applied with a moderate initial tightening it takes care of itself and the load without further attention. The shrinking of the cable under load which causes ordinary clips and clamps to become loose is counteracted by the cam which increases its grip as the load increases. One cam-clip assures an efficiency over 70 per cent, and two, up to 85 per cent or more

all practical purposes, 100 per cent efficiency, as the fastenings are as strong or stronger than the cable itself during the latter part of the period that the cable is in use.

Some authorities hold that it would be a safety provision on some classes of excavating machinery to provide fastenings that fail when the load passes the elastic limit of the cable, or at 50 to 60 per cent of its ultimate strength. Their reason for



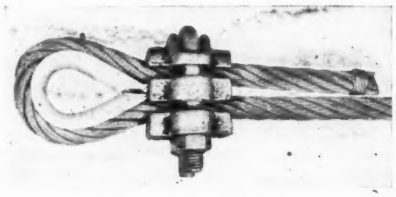
This type of wedge clamp is used to a considerable extent on electrical line work. Its holding power depends entirely upon the thoroughness with which the wedge is driven home

this is that cables worked over sheaves and drums beyond the elastic limit are rapidly destroyed, especially on undersize drums and sheaves with which excavating machines are usually provided. A failure at the fastening would then show that the cable was being worked beyond its elastic limit and the loss of a few inches of cable would be as nothing compared to the saving of the remainder of the cable, accomplished through failure of the fastening under those circumstances. Such a failure in the fastening might also prevent overturning of a machine if it were in an unfavorable position and the intensity of the load was unknown. Thus, while 100 per cent fastenings are desirable, as a rule they are not needed, and sometimes are not wanted, which is very fortunate in view of their scarcity or impossibility of attainment.

The so-called "leaded" or "babbitted" socket was evolved in the early days of wire rope, when all such ropes were made of iron wire of low-tensile strength. Commercial sockets in use today are practically the same size, weight and strength as the original sockets, while being used with cables ordinarily 50 to 500 per cent stronger than the first iron cables. The basket section of the sockets was originally designed to cover a sufficient length of the cable with the bonding metal—lead or babbit metal—to develop a total bond sufficient to pull the cable in two. Of course, then, if the same bond is provided for cables five times as strong, they will pull out just as they did in Bureau of Standards tests where the baskets were even longer than those in commercial sockets. "Leaded" and "babbitted" sockets have been used for a hundred years and in all likelihood will continue to be used, but for the sake of safety all commercial sockets should be provided with baskets sufficiently deep to provide a bond with lead or babbitt equal to the ultimate strength of the strongest commercial grade of cable when new.

How To Attach Sockets

The theorist will consider this a useless expense and say substantially this: "Use our sockets; follow our directions for attaching them and we guarantee you 100 per cent fastenings: 1. Cut off the end of the cable squarely. 2. Serve it tightly with a dozen turns of serving wire, beginning at a distance back from the end equal to the depth of the socket basket. 3. Open up the strands, cut out the hemp core down to the serving, wipe carefully each individual wire to remove grease and all other

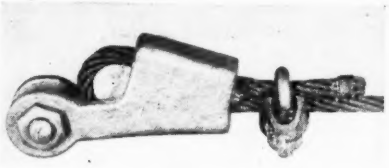


This U-bolt operated friction clamp, while less destructive to the cable than clips, is less likely to take sufficient hold of the cable to support even a moderate working load. Wire rope users have learned to distrust friction clamps and favor clips because of their tendency to bite into the cable. This clamp used alone would hold twice as much with the central and top pieces removed, making a common clip. Several per fastening must be used and those carefully watched

foreign matter and straighten each wire. 4. Fix up a half-and-half mixture of muriatic acid and water and hold the frayed end of the cable in this mixture for one minute. 5. Wipe the wires dry, squeeze the ends together and thrust them thus into the end of the socket. 6. Align the cable with the central axis of the socket and clamp in this position. 7. Plaster fire clay around the bottom of the socket, sealing all openings between it and the cable. 8. Pour in the melted bonding metal, which must not be lead or babbitt metal, but pure zinc."

To this the practical man is going to reply: "We are glad to know how to make 100 per cent fastenings with wire rope, but the process you describe requries a chemist, a metallurgist and some laboratory equipment, none of which are available to the ordinary wire rope user." You need the chemist to first clean the cable with acid and then to remove the acid, because the chemist, knowing the corroding action of acid on iron, would spend an entire day if necessary in removing the acid that was taken up between the wires by capillary attraction into the cable at the serving, there to augment the so-called "failure from crystalization by bending, due to the vibrations of the cable," to which ordinary sockets are subject. You need the metallurgist to watch the temperature of the melted zinc. Even under the most careful factory conditions, wire in galvanizing is reduced approximately 10 per cent in tensile strength; how much more is it likely to be reduced in strength when the zinc is heated red hot to make it run through the wires easily, as would likely be done? Machinists, millwrights, riggers, hoisting engineers, carpenters and the casual workman are the type of men who ordinarily fasten cables. They read little, but learn their work by watching their predecessors. Zinc, lead and babbitt metal are all one and the same to these men and used interchangeably. What, from their standpoint, would be more natural or reasonable than to use babbitt metal with a "babbitted" socket or lead with a "leaded" socket. Zinc? Never. No, it is far safer to use a mechanical fastening with a reasonable efficiency than the socket with its hoped-for 100 per cent efficiency, but more probable 25 to 50 per cent efficiency.

A mechanical fastening may be reasonably efficient when properly applied but, like the socket, too complicated to use under ordinary working conditions. Mechanical fastenings may be very simple in construction and appearance, too; yet too complicated in operation for safe use under ordinary working conditions. Any device worthy of use as a cable fastening



This is the wedge-socket, assembled and ready for instant attaching. The clip is only lightly attached, to prevent the wedge from dropping out before the initial pull on the cable. It is practically infallible and foolproof

must be dependable under ordinary working conditions and, to merit the name of being a safety device or to merit consideration as a standard fastening, it must guar-

antee the security and safety of all cables on which it is used.

Since the efficiencies of the vast majority of wire rope fastenings are unknown and the frequency of failures indicate the average efficiency to be dangerously low in spite of the various methods and devices employed, let us examine into the nature of wire rope and ascertain what there is about it to cause this situation. In hoisting ropes, the most important class, we have a material smooth of surface and heavily greased, flexible, highly compressible, and with the dangerous property of shrinking in diameter under load. Furthermore, it is weakened when deformed under load by clamps, weakened by acid and lye when these are used for cleaning and not removed, and weakened by heating beyond a certain point. With these complications must be considered the fact that, although the various grades of any one size have exactly the same appearance which causes them often to be used interchangeably and indiscriminately, they vary in strength as much as 500 per cent. From a safety standpoint, therefore, the inevitable conclusion reached from a consideration of these points is for a one-clamp or single-unit device, applicable to all grades of cable with equal safety.

The three-bolt clamp derives its holding power through frictional resistance induced between the surfaces of the clamp and the cable by the U-bolt pressure when the cable is under load. While not a destructive clamp, enormous U-bolt pressure is necessary

To solve the problem of fastening wire rope mechanically, there have been designed various types of friction clamps, distortion clamps, clamps that derive their holding power from lateral contact of ridges and grooves with the strands in the manner that screw threads operate, and clamps that contain combinations of these principles; bolts, wedges and cams being the means of operating them. All are more or less adversely affected by the peculiar properties of wire rope, but particularly by its compressibility in conjunction with its greasy surface. Catalogs and technical articles pertaining to the use of wire rope mention as a matter of course that clips and clamps to be safe must be correctly applied as to position on the cable, correct as to number, and correct as to degree of tightness. Furthermore, even then they are expected to slip and must be regularly inspected and retightened from time to time.

Spliced-in-thimbles have an efficiency of around 90 per cent. This is a 5/8-in. mild-steel cable and it required an expert at McCook flying field 2¼ hours to do this job. It is out of the question for anyone but an expert to undertake a job of splicing

When fastening failures occur, as they often do by clips virtually cutting the cable in two from overtightening, the fault is laid to a poor cable; when failure occurs by the slipping of the cable through the clamps because of insufficient tightening or an insufficient number, the operator is blamed. With ordinary clips and clamps there are any number of positions in which they may be applied; there are various weights of clips and clamps of the same pattern for the same size cable; there are an infinite number of degrees of tightness from which to guess at the correct degree, and as for the regular inspection of fastenings and retightening them, it is impractical although admittedly necessary. No wonder, with this intricate set of conditions and the clips and clamps that demand their performance, wire rope fastenings must be coddled and, lacking that, fail. Since at least ninety-nine out of every one hundred cables are fastened by men who have hardly the remotest conception of the scientific principles involved in the various cable-fastening devices, there can never be even a moderate degree of safety guaranteed until devices are provided that insure safety regardless of their position on the cable, regardless of their degree of tightness, regardless of the number used, and regardless of the strength of the cable.

This fastening guarantees an efficiency of about 50 per cent; also, that the cable will break in the half-hitch under an appreciably greater load. Those who use this method have learned that it is more dependable than any other method they know of. They are willing to sacrifice any hoped-for efficiency over 50 per cent

Wedge Sockets for Cables

A device which insures safety is the wedge-socket. It consists of a tapered, hollow metal shell, open at both ends, with a metal wedge having the same taper. The wedge is grooved to fit the rope and the inside of the shell is likewise rounded on two sides to receive the cable. The wedge is placed in the bite of the rope and the cable inserted, ends first, into the large end of the shell. A pull on either end of the cable draws the whole down into the shell, wedging the cable into the rounded sides, where it resists the heaviest strains put upon it. In practice, of course, the unloaded end of the cable need be no longer than to project out of the socket.

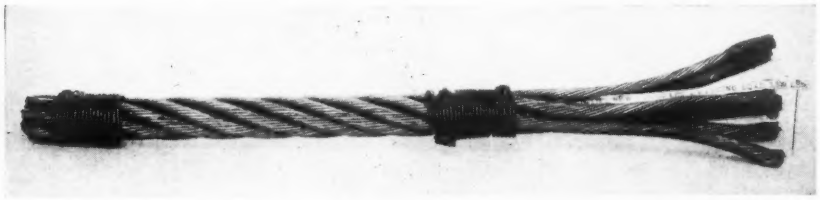
The wedge-socket was in use, in modified form, on elevator work more than 20 years ago, but was abandoned, presumably because it is not a "100 per cent" fastening, like the so-called babbitted socket when attached with zinc spelter by experts. However, it is becoming largely used now on heavy-duty excavating machines where clips, clamps and babbitted sockets of the common types have proved inadequate with the high-strength steel cables and the severe service demanded of them. As at present constructed, these wedge-sockets never fail by slipping, but can always be depended upon to pull the cable in two if tested to failure, giving an efficiency of from 70 to 80 per cent with a new cable. Doubtless, by increasing the length of the wedge and the shell, which would distribute the pressure on the cable over a larger area, higher efficiencies could be obtained, if desired, but as before mentioned, since hoisting cables are ordinarily used until worn to 65 per cent of their original strength, efficiencies of from 70 to 80 per cent in the fastenings are ample.

Effect of the lack of a standard cable fastening of any kind for the past hundred years naturally has resulted in the appearance on the market of a large variety of clamps and, as could be expected with any commercalized article, price has largely controlled their use. The strength, reliability and efficiency of a clamp has today very little control over its use; price, in fact, has been everything. Consider the common clip. Its holding power depends largely upon the strength of its U-bolt; the 5/8-in. clip is used more than any other size. Today there are on the market 5/16-in. clips with 5/16-in. U-bolts, 3/8-in. U-bolts, 7/16-in. U-bolts, 1/2-in. U-bolts, 9/16-in. U-bolts and 5/8-in. U-bolts! And a 5/8-in. clip with a 5/16-in. U-bolt, applied by an expert, is likely to hold more than a 5/8-in. clip with a 5/8-in. bolt when applied by the ordinary wire rope user! With the wedge-socket the case is different, for it holds the same no matter how applied. However, if ever decided upon as a standard fastening, the design, dimensions and material of which it is to be made would have to be specified, otherwise commercial competition would cause its early relegation to the low scale of the common clip.

Making Clips in Multiple

In many installations of wire rope it is impossible to use sockets advantageously, so clips of one kind or another will always be in demand. However, for the sake of safety, the common type of clip should be

made much more uniform in size than is the case at the present time. For instance, the heaviest pattern of ½-in. clip now on the market has a ½-in. U-bolt and three of these are recommended by the manufacturer for use with plow-steel cable. Presumably that manufacturer has made tests and ascertained thereby that three of his clips, properly applied, give a reasonable efficiency in this case. He also recommends that no less than two of his clips should ever be used on any grade of cable. Now to prevent the ordinary, inexpert wire rope user from not guessing the correct number, it would be a simple matter to manufacture three bases in one piece. This same manufacturer instead of using U-bolts 1½-in. in diameter with his 1½-in. clips and requiring three clips to the fastening as with his ½-in. clip, thus maintaining a consistent ratio, uses U-bolts of only ⅞-in. diameter with his 1½-in. clip and requires six to the fastening instead of three. There is absolutely no reason for this that outweighs in importance from an adverse standpoint the confusion it causes, yet all the manufacturers do it.

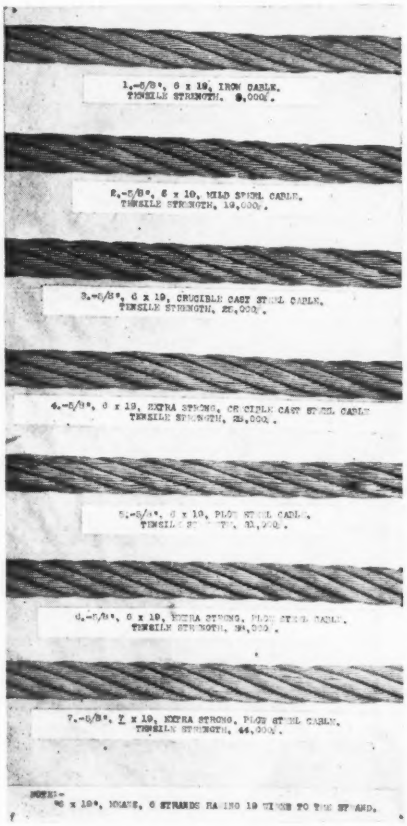


Identification tape can easily be woven in the rope like this to give strength and safe working load, and thus avoid many accidents

Clips on the market today are designated as "forged-steel clips" and "malleable-iron clips." "Forged-steel clips" have forged steel bases only, the U-bolts being made from mild steel rolled rods. "Malleable clips" have bases made of malleable iron and U-bolts also made from mild steel rolled rods. For wire-rope clips, malleable iron is a more satisfactory material than forged steel, because, being softer, the wires imbed themselves in it without being damaged to the extent they are with forged steel bases. This feature, in conjunction with the more scientifically shaped gripping surface of the "malleable" clip, obtainable by the molding process and impossible to obtain by the forging process, makes the "malleable" clip the more efficient of the two, when of the same weight.

Why Standardization Is Needed

Some manufacturers of forged steel clips refer to the "malleable" clips as "cast" clips for the purpose of creating the impression that "malleable" clips are made of cast iron. As a matter of fact malleable iron is as far from being cast iron as forged steel is. Cast iron is a commercial product used for making window weights and other cheap products of iron that get little strain of any kind. It is made out of old scrap that is worthless for any other use and after being cast receives no further treatment to change its structure internally. Steel, as everyone knows, is cast into ingots when it comes in a melted state from the furnace, but no one thinks of calling it "cast iron" although it would be, in the sense that malleable iron is "cast iron." Malleable iron is a prepared mixture with definite amounts of various elements, just as steel is; furthermore, after being cast into the desired shape it is put through a long, expensive annealing process that requires a minimum of 6 to 7 days and sometimes as much as 14 days to complete it. After the annealing process the iron has a different internal structure throughout, having about the same tensile strength as rivet steel, 50,000 to 60,000 lb. per square inch, and able to withstand severe hammering and bending without rupture. It is then known commercially as malleable iron.



These seven pieces of wire rope have the same appearance but vary in strength about 500 per cent. The importance of marking each cable, as a matter of safety and economy, with its rated tensile strength, working capacity, minimum safe drum diameter, and manufacturer's name and address, is obvious

Of course, any manufacturer can make poor malleable iron if he wishes, just as any wire rope manufacturer can make inferior wire rope, by trying to make it too cheaply. Forged steel is not necessarily a reliable material, for it, too, must receive a heat treatment before articles so made are ready for the market. Forged steel ordinarily is an extremely hard and brittle material immediately after the forging process is completed, unfit in this condition for use for wire rope clips.

It is obvious to the engineer that no matter of what material clips are made, the stresses imposed by the U-bolts are relatively the same, and that therefore, for each clip to have equal strength, it is only necessary to proportion the material in the boxes to conform to the relative strength of the materials used—granting that the U-bolts are of the same size. The ratio of the tensile strength of malleable iron to that of heat-treated forged steel is closely 1 to 1.33. Also, the degree of hardness closely approximates their relative tensile strength, and hardness is not a desirable quality. Here again we see the necessity for standardization to establish safe designs, but to insure strict conformity to standard dimensions every clip should be marked with the manufacturer's name.

Some wire rope users require galvanized clips, and often specify that they be "hot-galvanized." Their acceptance of "cold-galvanized" or electro-plated clips without question, however, indicates that they do not know the difference. Hot-galvanizing means that the article is dipped into molten zinc to receive its rustproof coating. It is an easy matter to so coat wire rope clips but the threads of the bolts and nuts become so clogged with the metal that it is impossible to use them without rethreading which, of course, removes all the zinc; therefore there is no advantage to be gained by hot-galvanizing.

In the cold-galvanizing process, the zinc is deposited by hanging the article in a battery solution and depositing the zinc by electric current. All clip U-bolts that are galvanized are galvanized in this manner. There is another process of depositing zinc, in a gaseous state, called sherardizing, after the name of the man who evolved it, but although very effective it is too expensive for commercial use with wire rope clips. Some manufacturers plate the U-bolts and hot-galvanize the bases, but there is no

advantage in that; in fact, it is a decided disadvantage with malleable clips, as the heating incident to hot-galvanizing is quite likely to nullify the effect of the previous annealing and render the material brittle once more. Cold-galvanizing or electroplating has no deleterious effect on malleable iron.

Wedges of Doubtful Value

Among the various types of clips and clamps there have appeared on the market several operated with wedges instead of bolts. These have the advantage of speed in application but little, if anything, more can be said of them, although it is claimed of some that they have a self-tightening action that makes them more reliable than common clips. Tests do not bear out these claims except where the wedges are made sharply saw-toothed on the side next to the cable, thus increasing the co-efficient of friction between the wedge and the cable over that between the back of the wedge and the shell of the clamp. Ordinarily, unserrated wedges have a lower coefficient on the side next to the cable because of the cable's natural smoothness and compressibilty, which is further accentuated by the presence of grease on the cable. Telephone and telegraph linesmen use clamps with both smooth and serrated wedges and, in addition, three-bolt friction clamps and ordinary clips.

A few years ago there came out a patented cam-operated clamp which appears to meet all requirements as a safety device and be worthy of consideration as a standard clip. In appearance it is substantially like the common clip except that a cam has been added and is attached to the U-bolt, where it serves both as a self-tightening device and a pressure distributor for the U-bolt, thereby eliminating the danger of cutting the cable incident to overtightening the U-bolt. Its action is positive and effective, whether applied loosely or tightly.

Tests show the efficiency of this cam-clip to be between 70 and 80 per cent, used with the various grades of cable, including improved plow steel, and it appears to make no difference whether the cam is attached to the running (short) end or the standing end of the cable. These efficiencies were obtained by using but one clamp; higher efficiencies, up to 90 percent, were obtained with two, the cable in every instance breaking inside the clamp, as is usual with all arrangements of clips and clamps that will take a breaking test without slipping. The U-bolts of this clamp throughout the various sizes are in all instances the same in diameter as the cable and the other parts also proportionally made, thus insuring the same efficiency in all sizes. It is absolutely necessary, from a safety standpoint, that all proportions be maintained in this clamp. Designed for a 1-in. plow steel cable it has a U-bolt made of 1-in. stock. A U-bolt made of ½-in. stock would doubtless hold a 1-in. iron cable, but would certainly pull in two with a plow-steel cable. This shows the necessity for making rules to prevent cutting weights, which is the inevitable result of commercial competition.

There are many other types of clamps, some of which are illustrated herewith, but it is not worth while to go further into an analysis of them here, the purpose of this article being merely to aid the reader and particularly the wire rope user in recognizing the difference between dangerous and safe conditions in connection with the use of wire rope.

There are still one or two details along the line of cable fastenings that are worth bringing to notice, one of which is the slovenly manner in which cables are attached to drums. Most building codes recognize this condition by stating that there shall never be less than three turns of cable on the drum. This will do all right for elevators, where the travel of the car is between fixed limits and where inspections are regularly made, but it is not sufficient for derricks, hoists and cranes where the full length of cable available is often needed to move loads out of ordinary reach. Many a load has been dropped and many a boom smashed by trying to use all the cable on the drum, and it isn't because of a sudden jerk either, but because the end of the cable inside the drum is not fastened at all. To be sure clips are used, sometimes to fasten a loop around the spindle inside the drum and sometimes merely to act as a knob to prevent the end of the cable slipping through the hole in the drum-shell, but are not effective.

Clips Inside the Hoisting Drum

So far in dealing with ordinary cable fastenings it has always been admitted that there is a chance, at least, for a safe fastening, but here are two conditions that do not permit of safe fastenings. 1. It is a physical impossibility for a man to reach inside an ordinary hoisting drum and obtain a purchase with a wrench on the clips there and tighten them sufficiently for the cable to take anything like a working load. 2. There is no clip on the market of the ordinary type that can be effectively tightened against a single cable to serve as a "knob," either inside or outside of a drum, because usually the legs of the U-bolt are not threaded the full way and the space between the curve of the U-bolt and the concavity of the clip-base, therefore, cannot be taken up sufficiently to obtain a good grip on the cable.

The practice of using hexagonal nuts, usual with ordinary clips, is one that promotes danger and for that reason might well be discontinued. Here lies the trouble: With ordinary wrenches the corners of hexagonal nuts are easily abraded, often making it impossible to get a good purchase on the nut, and this is particularly true with worn wrenches. However, no wrench that is usable at all will fail to allow a purchase on a square nut. The fact that the legs of the U-bolts of most clips are too close together to permit the use of square nuts argues nothing. As a matter of fact, competition and lack of standard specifications has resulted in bringing the common clip down to a mere shell in which even hexagonal nuts are with difficulty tightened, because of the lack of space for the wrench to work in.

After an intelligent selection of wire rope has been made and it has been safely fastened, it lies with the hoisting engineer to see that it is intelligently used and thereby accomplish his hoisting work with safety and economy. If the printed tape has accomplished a part of its intended purpose, the engineer not only knows the type of rope to use but, by an inspection of the dimensions of the drums on the machines he uses, will be able to ascertain whether he is really going to work the rope or simply abuse it. Competition in the commercial handling of machinery that employs hoisting ropes is keen, and the most fertile means of reducing the cost of it is in reducing the diameter of the drums.

The Mining Congress at Cleveland

CELEBRATING 25 years of remarkable development in the mining industry, the twenty-fifth annual convention of the American Mining Congress will begin next Monday, October 9, and continue until the 14th. The convention will be held in conjunction with the National Exposition of Mines and Mine Equipment and it gives every promise of being the largest and most representative gathering of mining men which has ever been held.

Among the special features of this important national meeting is the exposition of mine machinery and mine equipment giving the operator an opportunity of studying the latest forms of labor saving and cost reducing equipment.

There will be exhibits of great interest to our own industry that will reflect its development and it is urged that a good attendance will be shown.

In accordance with its usual custom, Rock Products will have a booth—No. 78—and exhibit fine collections of specimens of sand, gravel, crushed stone, lime, cement, gypsum, phosphate rock, talc, slate, diatomaceous earth, slag, etc. They will also include a very interesting and complete collection of limestone. One of our own staff who has traveled from one end of the country to the other visiting operations, has had an important part in collecting our exhibit. He will be in charge of this exhibit and will be more than pleased to tell you all about it. By all means attend the congress if possible.

How to Choose Crushing Plant Steel*

Why do shafts and frames and other parts fail? The answers below to this and similar questions tell quarry operators what they ought to know about the steel they use

By W. R. Shimer
Sales Metallurgist, Bethlehem Steel Co., Bethlehem, Pa.

IT was my original intention to present a paper containing definite recommendations for the more important iron and steel parts used in machinery for the manufacture of cement. Upon going into this phase of the subject in detail, I find that, due to various local conditions, a steel which is satisfactory for a certain part of cement plant "A" may not be suitable for the same part at cement plant "B." This is due to various reasons such as difference in hardness of rock, type of machinery, condition of machinery, personnel of men operating the machinery, etc. I will, therefore, confine myself to more or less general remarks and attempt to show how to obtain steel which will best suit the purpose and how to draw up specifications which will assure a satisfactory product.

A Shovel Shaft Failure

The writer cannot claim to be familiar with the mechanical details of cement machinery, and is, therefore, not in a position to ascribe failures to faulty design, although from an examination of certain failed parts there is every indication that some of the failures can be attributed to error in design. For example, the writer had the opportunity to investigate the breakage of shafts in an electically operated shovel. This shovel was operated in the same quarry with two steam shovels. No shafts were known to break in either of the steam shovels, while the shaft breakages in the electric shovel were quite frequent. The writer was called in on this matter after the cement plant had proven to the engineer who built the shovel that power was developed which stressed the shaft to a load of twice that for which it was originally designed. In other words, when the electric shovel was attempting to dig out the side of a hill in one scoop, and since an electric motor will withstand a 100 per cent overload momentarily, the shafts were stressed to double the amount for which they were designed, and as this stress was a sudden one, the shafts naturally twisted off. I understand that when a steam shovel is over-stressed, it will stall; there are no sudden shocks, and consequently shaft failures are much less frequent in shovels of this type.

The shafts in the electric shovel could not be made larger without making very radical changes throughout the entire mechanism, and it was, therefore, necessary to use a special nickel chrome steel, heat treated to give more than twice the elastic limit of the original shafts, and at the same time the elongation and the contraction of area had to be fairly high to insure sufficient ductility to withstand the usual shock and vibration.

The physical properties of the failed shafts showed approximately the following:

Tensile strength	62,000
Elastic limit	32,000
Elongation, per cent	35.5
Contr. of area, per cent	61.07

The heat treated alloy steel shafts showed:

Tensile strength	112,000
Elastic limit	90,000
Elongation, per cent	22.5
Contr. of area, per cent	64.0

These physical properties more than make up for the deficiency in the size of the shaft.

It might be of interest to mention in this connection that for quick repairs, cold drawn shafting was used for shafts in this shovel, and some broke in one week's time.

Cold Drawn Shafting

While on the subject of cold drawn steel, I mention its properties and the object in using it. It is made by picking all the scale from the hot rolled bar, which is then pulled through a die 1/32 to 1/16 in. less in diameter than the original bar. This produces a bar of accurate size, with a smooth, bright finish. The bar is reduced cold and while cold extends in length in proportion to the amount of reduction in cross section. Low carbon steel is cold drawn without annealing, but the higher carbon and alloy steels are annealed first. The physical effect of this cold working is to raise the elastic limit, in the smaller diameters, up to approximately 90 per cent of the ultimate tensile strength, with a corresponding decrease in ductility. Prior to cold drawing, the elastic limit of the same steel approximates 50 per cent of the tensile strength, with considerable ductility. I would not recommend that cold drawn steel be used for important structural parts which must withstand shock and vibration. It is an excellent steel for screw stock, bushings, sockets and parts of this nature which must be turned out cheaply by the thousands on automatics. It is satisfactory for line shafts and other parts of like nature which are not highly stressed. Some years ago an automobile company in an attempt to save money on lathe work used for a time a cold drawn alloy steel for axles. They were drawn to finished size, and all the machining that was required was to cut to length and mill the ends square. This proved to be expensive economy, as these axles failed in many of the cars after short service, and replacements were made free of charge in order to satisfy the car owners. The replacing axles were made of a special heat treated alloy steel, and they returned to the practice of turning the bars on a lathe rather than to obtain the accurate size by cold drawing.

Why Many Parts Fail

Cold drawn steel has its field, and I do not wish to be misunderstood concerning it. It is, however, false economy to use it for highly stressed parts, as there are so many steels which can be heat treated to stand up under severe service and which will far outlive cold drawn steel.

Many parts fail in cement machinery on account of not being heat treated or having been improperly heat treated for the service to be performed. Many times steel of correct composition for a certain use fails in a very short time, because of improper heat treatment. When properly heat treated this same steel will give satisfactory service. As a concrete example of this I will cite the case of an order we received some years ago for 10 bars of nickel steel 4 in. in diameter. This order was received from a drop forge concern and from the composition of the steel ordered. It was inferred that the steel was to be cut up and forged into gear blanks, which were to be subsequently heat treated. This steel was,

*Presented before a recent meeting of the Portland Cement Association.

therefore, shipped to the consumer in its annealed condition, having been annealed for machinability. A short time later we received a complaint, stating they had made piston rods from three of these bars and put them in drop forge hammers. One lasted 2½ hours and broke, another lasted 5½ hours and the third lasted about 15 hours. They stated this so-called high grade nickel steel was inferior to brass or wrought iron. The remaining seven bars were returned and given a special heat treatment by quenching in oil, with subsequent annealing, and were returned to customer and were found to be entirely satisfactory. This is one of the many examples which could be cited to show that while steel properly heat treated is satisfactory for the service required, steel of the same heat but improperly heat treated is not satisfactory. I might mention that in order to obtain the best service from alloy steels they must be heat treated, as it is not good economy to use them otherwise. When heat treated they are far superior to ordinary steels.

Attention Necessary to Steel Castings

Proper attention is not always given to steel castings, due in part perhaps to the users feeling that because the casting was made of steel instead of iron that it had all the strength that was required, with the result that no check was made as to the analysis of the steel or to its annealing. This applies, of course, to commercial castings. There has come to my attention quite a few failures of machines where steel castings have been used. The machines in mind at the present time are large jaw crushers.

Up to a few years ago, the primary crusher was fitted with a jaw opening of about 24x36 in., but with the advent of steam shovels it became necessary to increase the size of crushers, with the result that these machines are now built with openings up to 5½x7 ft.

In the designing of these larger size crushers, the manufacturers went to the use of steel and made a great many of the crushers in sectional design, i. e., the side frames and end frames being separate casting, machined and held together by turned bolts.

Another design of crusher consists of a "semi-steel" frame reinforced with a cast steel band which is shrunk around the bottom of the frame and a cast steel band around the top. The design of this crusher is such that the steel bands take all of the crushing strain.

The failures of these steel crushers have been due partly to the fact that the analysis of the steel was incorrect, and partly to the fact that the castings had not been properly annealed, if annealed at all. In one of the large plants, not so long ago, there was broken in operation a crusher in which the frame was 20 ft. long and the cross section of the steel about 6 in. by 5½ ft.

Cause for Breakage

The breakage of these castings showed that the steel was very coarse grained and that it had not been properly annealed, with the result that original strains were still in the castings. Had these castings been properly annealed, there is no question but that the machine would have stood up and that the breakage would not have occurred. The repairs to this particular machine will cost the operating company many thousands of dollars, as the machine will first have to be banded together to permit it to continue to operate, and later the side frames entirely replaced with new castings.

There has also been brought to my attention the failure of a crusher which was reinforced with a heavy steel band. This band was of oval shape and had a wall cross section of 5x24 in. It broke at three points almost simultaneously, and the nature of the breaks indicated brittleness. Upon investigation it was found that the casting was too high in carbon and further that it had not been properly annealed. The microscope showed a structure of steel in the same condition as when cast, and if it had been annealed at all, it only went through the motions of this operation, as there was no indication whatever of annealing from the examination of the casting itself.

Foundries or forge plants will often, in order to fill up their shop, take on work for which they are neither trained nor equipped to handle. Sometimes, by good fortune, their product stands up in service, but in many cases like the one just cited it did not, and caused considerable loss to the cement plant and considerable embarrassment to the crusher manufacturer, who was not directly to blame. Manufacturers of machinery should, however, investigate the foundry prior to placing orders for castings, to determine if they are competent to make such castings, and the castings should be inspected to be sure they are of the right composition and properly annealed.

Testing the Castings

The practice generally followed is to specify certain physical properties in accordance with the specifications of the American Society for Testing Materials, these tests being taken from coupons which are attached to the casting and heat treated with the casting. Test coupons are integral with the casting. They should not be broken from the casting until it has been heat treated. If, by accident, the coupons should be broken off prior to annealing, they should not be heat treated separately, but should be charged in the same annealing furnace at the same time with the casting in order that it receive identical heat treatment with same. This is necessary in order to be assured that the physical results obtained from the coupon represent the physical properties of the casting itself.

Failures such as those just briefly cited might mislead prospective purchasers into believing the machinery itself was at fault. In cases of this kind, no reflection can be cast upon the make or design, because the failures are directly due to the fact that the makers of the castings did not furnish a good product. It is always unwise to place an order for a special part to the lowest or any bidder, without first having been satisfied as to his ability to furnish a satisfactory product.

What the Average Engineer Does Not Know

I believe I am safe in stating that the average mechanical engineer knows steel only in a general way, as he has neither the time nor the opportunity to keep up to date with the rapid advances made in this art. Even we, who are working on this subject all the time, find it difficult to keep pace. An engineer will design a part and figure on a certain factor of safety, for example of 5 to 1, when he expects to encounter shocks, etc. With this factor of safety he may require steel of say 110,000 lb. elastic limit, which predetermines an ultimate strength of approximately 140,000 lb., but loses sight of the fact that to meet this high elastic limit, the elongation and contraction will be relatively low, and he will have a steel lacking in ductility, so that the real factor of safety is actually much lower. For such a highly stressed part, he would have a more satisfactory product if he used a factor of safety of 4 to 1, and asked for a steel having, say 90,000 lb. elastic limit, with proportionately lower tensile strength, since he would have a corresponding increase in ductility, thereby enabling the part to withstand shock and vibration.

One big problem in some plants is to obtain satisfactory shafts for gyratory crushers. Low to high carbon steels and alloy steels heat treated for high tensile strength and elastic limit have been used, but certain plants still have more breakages than they should. I have been investigating this subject with a view to developing a satisfactory steel and a heat treatment for this purpose. In general, I find the tensile properties need not be high, but the important properties are elongation and contraction of area. The shafts which on the average stand up longest in service are those with greatest ductility.

I have interviewed a number of cement plant operators who use the gyratory crushers and find such shaft failures are peculiar to certain plants, while others rarely if ever have this trouble. The plants which have no failures attribute their success to the fact that they made a special effort to keep dipper teeth, sledge hammers, and other

iron and steel parts from going through the crusher. The penalty to employes allowing such parts to go through is dismissal. I am inclined to believe that this is one of the major reasons for shaft breakages as this would explain why the harder shafts are more susceptible to failure than the softer and more ductile ones. When a large piece of steel passes through a crusher, something has to give, as the crusher itself cannot stall. If the liner plates do not break, the shaft must distort A hard shaft will act as a spring, but the excessive strain which has been put on some points, usually on the outside surface, will produce a nick of perhaps microscopic size, which we might call an incipient break, and during continued service, it grows larger, finally resulting in the fatigue break, which these shafts manifest on fracture. The softer steel shafts will bend and at times even take a permanent set, but there is no doubt but that the increased ductility accounts for their being longer lived. When a plant has an unusual number of breakages of this nature, and if it is certain no foreign material has gone through the crusher, an investigation should be made by a competent party, as such a condition can generally be corrected either by a change of steel or by special heat treatment.

I understand some gyratory crushers are being redesigned in order to permit shortening of these shafts, and that these shorter shafts are reducing the breakages to a considerable extent.

Reducing the Breakages

I can easily imagine how the plant engineer, or the engineer building machinery, who might interview six to a dozen representatives from as many different steel concerns, could become confused when attempting to boil down the diversified information received. The same thing would happen if the writer were in the market for cement, and with his limited knowledge of this product, would have difficulty deciding whose cement was best after interviewing representatives from as many cement companies. I would probably purchase from the lowest bidder, and no doubt obtain just what I paid for, namely, an inferior product. The enthusiastic steel salesman may elaborate on the wonderful physical properties of a special alloy steel, representing results obtained from a small test bar, and leave the cement engineer to believe that these results can be obtained in a 15 or 20-in. diameter forging. Were the engineer to attempt to purchase a forging requiring such high properties, the reliable steel manufacturer would try to discourage such requirements, but the engineer might find some one hard up for work who would try to furnish it, and the chances for its giving satisfactory service would be very slight.

I believe I am safe in stating that cement machinery must stand as much or more abuse than machinery for most other industries, on account of the abrasive materials handled, and the considerable amount of dirt and dust always found in the cement plant, which becomes imbedded in bearings. Some parts must stand both wear and shock, and some must stand either shock alone or wear alone. In the case of parts which must stand both wear and shock, a happy combination can be obtained by means of case hardening the outside surface, which will resist wear, retaining a strong and tough core to resist shock. In the case of a part which is not subjected to shock, this can be made of a steel which can be hardened throughout. In the case of a part which must stand severe shocks and vibrations, certain steels can be specifically heat treated to stand up for this service. It is my impression that certain parts, such as gudgeons, liner plates for tube mills and crushers, are expected to wear out in a certain length of time, and replacing material is ordered without investigating the possibility of obtaining a material which will give double the service or better. It seems that breakages and excessive wear are accepted as a matter of course by many cement plants. There are manganese steel castings made which stand up best under certain conditions at one plant, while some other special steel casting or forging will give better service at another plant. Each plant has its own individual problems which can be worked out by the proper co-operation with reliable steel manufacturers.

Take pinions, for example. Cast iron pinions are cheapest if the first cost is considered only. Occasionally a cast iron pinion makes an exceptional record, but how often is a cast iron pinion obtained which wears out or breaks in a short time, usually breaking before being worn out, and where the cost of labor and curtailment of production on account of repairs would make the ultimate cost considerably higher than if good special steel, heat treated pinions had been purchased in the first place.

Worth the Price Paid—and No More

Satisfactory iron or steel for almost any purpose can be obtained if the manufacturer is acquainted with full details concerning requirements, and if he is paid the price. No matter what the commodity is, we generally receive the quality we pay for. When a cement company wishes a forging and is only willing to pay a certain limited price per pound, it will receive a forging which is worth the price paid for it and no more, since in order to make a forging at such a figure the steel manufacturer will have to select his steel accordingly, and perhaps at this price he cannot afford to heat treat it. If a forging is required, payment of a fair price to a reliable manufacturer will secure a special steel properly selected, and will insure careful heat treatment for the service required. Though such a forging might cost three times as much per pound, it would probably last more than three times as long; but if it outlives the lower priced forging only 2½ times, it would be cheaper in the end, on account of continued operation during this extended period and saving on cost of taking down and reassembling.

In the case of the steel casting failures on the jaw crushers, mentioned earlier in this paper, these castings would no doubt have been cheap at 50 cents a pound if they had not broken.

Engineer and Metallurgist Should Work Together

The cement engineer should work closely with the steel plant metallurgist and the cement plant purchasing agent should work closely with the cement engineer. In cases where the purchasing agent does not co-operate with the engineer, he will buy steel other than that specified by the engineer if he can obtain a reduction in price. This reduction in price may be quite costly, due to curtailment of production and cost of repairs on account of breakdowns. If there are parts which break or wear out too soon, the plant should look for something to give better service and go to a reliable source of supply, state what is wanted, with a complete history of the average service obtained from past material and details of its iron or steel composition. With such information the metallurgist should be able to recommend iron or steel, which would be more satisfactory, and while many times he may recommend a steel which will cost somewhat more, sometimes he finds a high priced steel being used where a much cheaper steel would have given as good or better service.

I wish to emphasize the importance of co-operation between the cement or quarry engineer or the engineer building cement and crushing machinery and the steel plant metallurgist. In our corporation we find it valuable for our plant engineers and engineers who are designing or building machinery to keep in constant touch with our metallurgical departments. When they design a machine to perform a certain operation they first consult the metallurgists to determine which steel will best stand up in service and the physical properties which can be obtained from this steel, and they then design their machinery accordingly. In some plants the designingengineer will design his machinery independent of metallurgical advice and make some parts so light and at the same time requiring extremely high physical properties that he works a hardship on the

metallurgical and heat treating departments which must resort to the use of high priced alloy steels, as they may be very sensitive to heat treatment and may crack and distort during the drastic heat treatments needed to obtain the extremely high physical properties. This results in high shop losses and often in the installation of defective parts, causing failure in service. Where there is close co-operation between the engineer and metallurgist, such a condition is not likely to occur, and although the machinery may be somewhat heavier, it will be more efficient. The metallurgist finds it necessary many times to consult with the engineer before recommending steels for certain parts in order to become acquainted with the exact details of the duty which the particular parts are to perform. We find in our corporation that neither can get along without the other, and certainly this same condition must hold true with the cement industry or any other industry using iron or steel.

Making It Easier to Compete with Local Materials

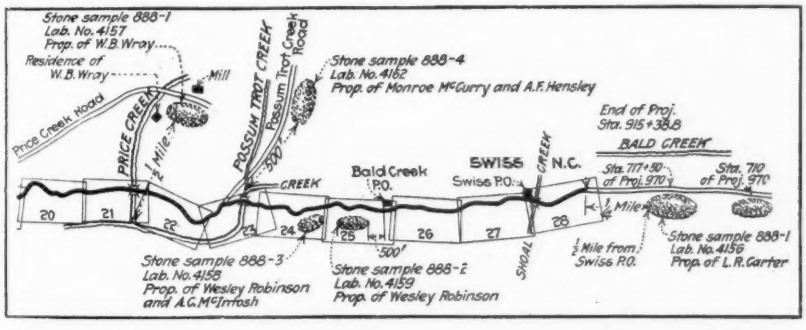
CLEAN and screened aggregates, commercially produced, and properly graded on the job, make the best concrete. Pit-run gravel, or improperly prepared bank material, can not compete on a quality basis. There are certain cases, unquestionably, where highway engineers are justified in accepting bank material if it passes sufficiently rigid tests. The highway engineer is responsible to the taxpayers of his county or state, and if he can obtain a clean aggregate that is well graded, so that an excessive quantity of cement is not necessary, he will probably provide a good quality of concrete highway at a considerable initial saving to the taxpayers.

One state of good roads fame uses principally commercially produced aggregates, but on some sections of its concrete road work several thousand dollars a mile have been saved by using bank materials. Broad-minded commercial producers of the state have become convinced of the wisdom of the action from the public point of view and no longer denounce the highway officials for their actions.

There are many cases, however, when the use of bank materials does not act for the ultimate good of either the taxpayer or the highway engineer, and here is where the expert knowledge of the commercial producer should enter to guard against the use of unsuitable aggregates.

If the commercial producer keeps himself posted on the activities of highway engineers and on the materials designated for use as aggregates he may save his community from poorly constructed roads and incidentally add to the volume of business.

Take North Carolina, for example. Local material deposits are located as new highway projects are developed, and maps furnished as explained below. If commercial aggregate producers of North Carolina will keep in touch with these maps, visit the deposits mapped, take samples and have tests made, they will have the information on which to talk intelligently with the highway engineers and local contractors on the relative merits of local supply and commercial materials. Producers in other states can equally well keep in touch with the work of the highway department.



Commercial producers, equipped with such a map, can investigate local deposits to see what materials they must compete with and to determine whether or not commercial materials can be profitably used in place of local materials

The aggregate producers should know more about aggregates than the contractor who uses them, and if the producer can show the contractor conclusive evidence that dirty bank material will produce defective cement, or that poorly graded material will require the use of 30 per cent more cement and thus make the concrete more expensive than with screened material, he is doing the contractor and the taxpayer a service at the same time that he secures a legitimate order for his clean and screened material.

Following is a description of the North Carolina method of procedure, as described in a recent issue of *Engineering News-Record:*

Sources of materials suitable for road construction are indicated by the Department of Tests and Investigations in a "report" which accompanies the plans for every highway improvement project in North Carolina. As each project is developed for improvement, a materials survey is made. All local materials deposits are searched out; their location and extent are roughly determined, and representative samples are sent to the headquarters testing laboratory at Raleigh for determination. When the tests have been made a map of the improvement is prepared on which are recorded the acceptable deposits and other useful information as indicated by the portion of the map for Project 888 which is illustrated herewith. This map is bound into a folder which also contains a typed list of the deposits and another typed list of commercial materials plants within the state.

The department does not guarantee the quantity or the continued quality of the deposits located, but lays all its data open to the contractor for such use as he may or may not decide to make of it. With a map, which accompanies all plans for a project, showing adjacent railways and stations, the materials survey map gives the contractor a fairly complete notion of the supply and transportation conditions which he has to consider in preparing bids and plans for the job.

Spain Wants Phosphates

AMONG the inquiries for American goods transmitted to the Department of Commerce last week by American consular officers, Spain ranks first with 17 applicants, one of which desires phosphates.

Anyone interested may obtain detailed information by addressing the Department at Washington or the nearest bureau, giving the number 3740*.

Overheard at Chicago

FIRST Producer: "I've got a thousand tons of sand I'd like to exchange for a thousand tons of gravel."

Second Producer: "I've got a thousand tons of gravel I'd like to exchange for a thousand tons of sand."

Both Producers: "Who'll pay the freight?"—*National Sand and Gravel Bulletin.*

Will the Crushed-Stone Industry Ever Wake Up?

BELOW is an anonymous letter which, by all the rules of editorial practice, should go into the waste-paper basket. Nevertheless, since the editors of ROCK PRODUCTS themselves could honestly subscribe to the sentiments expressed, they give it place here, in spite of its unknown origin.

Editors ROCK PRODUCTS:

I am writing at the suggestion of one of your subscribers, a crushed-rock quarryman, to whom I attempted to sell the services of my firm. They are business engineers, efficiency experts, and cost-finding accountants and systematizers, but have left this particular problem of the quarryman untouched for the reason that the aforementioned quarryman is a wary animal, and does not seemingly want any of the help which we have for sale.

From the available information gleaned from my crushed rock producer friend, the selling price of his product is not established by any method of "rhyme or reason," but by the competition he necessarily is forced to meet in order to market his product. If his selling department is not hitting on all cylinders, he finds himself oversold on some of the five, six or seven or more sizes of material manufactured, and it becomes necessary to make a place for the material unsold.

It would seem that his selling organization is faulty in not properly balancing the sale of the plant's output, or the plant is faulty in not being of proper capacity and design to manufacture at all times the market's demand, or to provide adequate and cheap means of storing and recovering such sizes as are necessary to manufacture, and for which the market demand is seasonal.

It is but natural for the sales manager to pass the buck to the production manager, and the production manager to the inadequacy of the sales department. And there you are until the boss surveys and remedies the situation. But—

What bearing has all this on the establishing of the price at which the product is sold? Is it along the line of least resistance for the boss to move the surplus sizes "at a price," or to provide sales ability or additional plant to take care of this surplus, so that it can be sold at production cost, plus overhead, plus a reasonable profit?

In other lines of business with which the writer is familiar, selling price is determined by adding together the cost of the article sold and a reasonable profit on the money invested in the business. My quarryman friend states that "hay must be made while the sun shines," and that the disbursements made for overhead, manufacturing costs, shutdown repairs, interest, taxes, insurance and other factors entering into the establishment of the selling price must be covered by an average operating year of eight months.

It seems to the writer that the rock producers are floundering in a mire of their own false pride and, like Macawber, waiting for "something to turn up" that will make it possible to at least add their depletion, depreciation and obsolesence costs to their selling price and get away with it.

It has been given to the writer that no two operations are similar, nor shipping facilities the same, but why is it not possible for some sort of an association of those interested in this business to get together and average these conditions for its members? I understand that there is some such association in existence, but not manned to the extent of making its influence felt among its members.

Why not make this association a real one—get together, establish an intelligible uniform cost-finding system which will embrace and provide for all elements of cost, including an adequate return on capital invested, and so establish a business yet in its infancy, and with tremendous possibilities for net earnings?

I am writing this, as stated at the beginning, without any personal interest other than my friendship and regard for my quarryman friend who—and he agrees—has not the nerve to risk being made the butt of the joke by raising this question.

If it is the means of putting this question of real profits before a quorum of your readers, my friend will be pleasantly surprised.

S. O. S.

Chicago, October 2, 1922.

Cement Producer Would Not Cancel European Debt

IT WOULD be unthinkable to ask the United States to cancel the debts owed by European countries, in the opinion of Sam Lazarus, president of the Acme Cement Co., of St. Louis, on his return from an extensive tour through England, France and Germany.

"I am in favor of giving assistance by a long-time loan at a low rate of interest to our debtors on the other side. Beyond that I would not go, and I do not believe the American people will sanction the canceling of any part of the debt that is so justly due us. It is a very good maxim to be just before you are too generous. Since the treaty of Versailles all of the new governments have been at war or at the edge of it.

"Germany is no longer the German Empire. It has lost all of its colonies and its merchant marine and is rather in the condition that the North was in after our civil war, only more so. France is no worse devastated than the South was.

"We had the women and children in the South raising cotton, and the men and boys in the North raising cattle and corn. We exported these products to Europe at European prices to pay our debts. If ever there was a war for humanity it was that one. We certainly received no assistance from Europe, either financial or otherwise, in that war."

To Complete Eastern Potash Plant

OFFICIALS of the Eastern Potash Corp. announce that arrangements have been made whereby work will begin at once to complete the corporation's big plant at Brunswick, N. J. The plans also include the plant of the Eastern Brick Corp., a subsidiary of the parent organization.

These plants, on the Raritan river, are now about 75 per cent completed. Delay is said to be caused by the big cost involved, upon which more than $2,000,000 has already been expended. Expectation now is that both plants will be in operation by the first of next year.

From well-known New Jersey green sand, a high grade of potash can be extracted, a potash that is 99½ per cent pure, and immeasurably superior to the German product. The residue of the green sand is a substance which makes exceptionally fine brick and other masons' building materials. This discovery resulted in the organization of the Eastern Brick Corporation.

The brick plant, when completed, will have an initial capacity of 200,000 brick a day.

New Phosphate Plant in Tennessee

THE opening of the new $400,000 phosphate plant of the American Agricultural Chemical Co., at Kleburne, Tenn., makes six large scale operators, with about 30 minor ones, in the Mount Pleasant region, says the *Wall Street Journal*.

For these mid-Tennessee plants the annual production has run 600,000 tons for two years and the rock in sight will allow the present scale to continue for the next 35 to 40 years. There has been no diminution of visible supply for 15 years.

Phosphate rock land near Mt. Pleasant sells for $1,000 an acre up. One tract of 200 acres recently brought $400,000, although at least half of it was known to be of mediocre grade.

Three-fourths of the production of the mid-Tennessee field, the second largest in the world, is used for fertilizer manufacture, the remainder being taken by baking powder companies, chemical works, steel plants as flux, etc.

Birmingham's New Cement Plant

WORK has begun on what is promised to be the most complete cement plant in the South—at North Birmingham, Ala. The estimated cost is $2,500,000. The annual capacity will be 6,000,000 bbl., and its design provides for an increasing capacity as soon as market conditions warwant it. The company is the Phoenix Portland Cement Co., and Eastern capital is backing it. Lindley C. Morton, of Philadelphia, is the president.

Temporary buildings, including the offices, are in course of construction, and all the preliminary preparations have been made, such as selection of site, rights-of-way, lettings for equipment, etc. The electrical equipment will be supplied by the General Electric Co.; the crushers, by the Worthington Pump and Machinery Co.; the driers and kilns, the Vulcan Iron Works; the tube mills, the Traylor Engineering Co.; the locomotive cranes, Orton & Steinbrenner; the traveling cranes, the Champion Engineering Co.; the pulverizer, the Bradley Pulverizer Co.

The site was purchased from the Sloss-Sheffield Steel and Iron Co., and is adjacent to that company's plant. In the 80 acres there is, it is said, sufficient material to produce some 200,000,000 bbl. of portland cement.

This plant will be of steel and reinforced concrete throughout. It is the present plan to complete the plant not later than May, 1923.

R. J. Hawn is superintendent of construction and will have charge of the plant when it is completed. E. P. Haubert, secretary and purchasing agent, will spend considerable time on the job in its early stages. R. S. Scott, the consulting engineer, is planning the power layout.

President Morton states that the property has disclosed limestone deposits of high quality. He said also:

"For some time the splendid possibilities in the South have strongly appealed to our company, and, about a year ago we quietly started our engineering department on a search to locate the best possible Southern site for the location of a modern plant for the manufacture of portland cement.

"After looking over some 20 deposits of raw materials and plant sites in three different Southern states, we finally located what we consider the most ideal site in the United States, right here in the heart of the Birmingham district.

"The plant will be served by the seven railroads in the Birmingham district. This should insure the very best transportation facilities to all parts of the South.

"At present the Phoenix Portland Cement Co. operates a modern cement plant at Nazareth, Pa., with a capacity of 1,000,000 bbl. annually. This plant has been manufacturing cement for the past 20 years, and during the past two years the plant has been entirely rebuilt and modernized and the capacity has been materially increased."

Survey of Eastern Kaolin Deposits

IN the course of a survey of the kaolin deposits east of the Mississippi river, conducted by the United States Bureau of Mines in an endeavor to locate American clays that could be substituted for imported clays, it has been found that New Jersey white clays are finest in grain, then clays from states in the following order: Georgia, Florida, Pennsylvania, South Carolina, Maryland, Virginia, North Carolina, and Mississippi. The clays from Georgia, Florida, Pennsylvania, South Carolina and Maryland vary from extremely coarse to extremely fine clays. All the clays tested from Virginia, Delaware, North Carolina and Mississippi were coarse grained. In investigations to determine the possibilities of improving the color of American clays after firing, it was found that 73 of the 80 clays tested burned to a fair white color, after refining the same by elutriation. A microscopic examination showed that the North Carolina, Delaware and Maryland kaolins were similar to the English kaolin in that they are composed of coarse crystalline kaolinite particles; clays from New Jersey, South Carolina, Georgia, Mississippi, Virginia, and Florida are composed largely of aggregates of fine-grained kaolinite.

Dolomite for Refractories

IF the lime in dolomite can be combined so as to render it nonslaking and at the same time hold up the refractoriness of the material, the abundant deposits of dolomite in the country would be rendered available for extensive use as a basic refractory, according to the United States Bureau of Mines. Briquettes containing 90 per cent dolomite and varying percentages of iron oxide and clay have been burned by the bureau at the ceramic experiment station, Columbus, Ohio.

Slaking time tests were run and the results plotted on a triaxial diagram. The slowest slaking mixture was selected for making into bricks which were burned to a high enough temperature to render the lime inactive. Bricks with a high fusion temperature and high specific gravity, great mechanical strength, and low porosity were the result. The work is being continued, using varying percentages of dolomite to determine the nonslaking areas over the entire field.

Proposed Chinese Cement Plant

PLANS are under consideration for the construction of a small cement plant in the vicinity of Kaying City, which is about 150 miles inland from Swatow, on a branch of the Han river, reports the U. S. consul at Swatow. The necessary materials are reported to be found in abundance in this district, and it is intended to test out the possibilities of this business by establishing a small plant which, if circumstances justify, will subsequently be enlarged.

Descriptive matter and proposals are desired for the cement-making machinery required for a complete plant. Proposals should be addressed to Ching Wen San, care of Messrs. Tek Hua Seng, Chaochowfu, via Swatow, China. Communications in English can be understood, but correspondence with Ching Wen San must be in Chinese. Transactions of this character should be handled through representatives in China, who presumably would be located in Swatow, Canton, or Hongkong, although possibly Shanghai representatives could reach this district.

Bed of Marl Near Brainerd, Minn.

THE discovery is reported of a large bed of marl about four miles square and 10 ft. deep a few miles south of Brainerd. It has been tested as to its lime content, and has been pronounced 85 per cent pure.

A University of Minnesota assistant chemist examined the deposit. Newspaper dispatches state that County Highway Engineer Walter M. Murphy has successfully used some of the marl on highways.

Has Concrete Many New Uses?

THIS question is easy to answer. Think of concrete boats on the Nile—it's enough to make the ancient boatmen turn over in their sarcophagi. The same sack of cement that is utilized for making an art window can also be used for the hippopotamus' swimming-pool; a garbage incinerator or a sarcophagus; a manhole or a front porch; a trolley pole or a cistern; a laundry tub or a shingle; a subway or a tennis court. Even our thoughts are concrete now and again. We'll say concrete has many uses.

Chemical Show a Big Success

THE Chemical Exposition, which was held at the Grand Central Palace, New York City, September 11 to 18, was on a par with preceding expositions in attendance and interest. Among its features were the exhibits of the National Lime and the Talc and Soapstone Producers' associations.

"We were more successful this year than last with our exhibit," declared Dr. Holmes, manager of the chemical department of the National Lime Association, to a ROCK PRODUCTS representative.

"The lime industry was represented by the exhibit of the National Lime Association. The exhibit this year featured new data and information about the utility of lime, but due attention was given to getting across the old reliable information about lime which, although well known to the men of the lime industry, is not known to the busy business executive of the chemical industries, who is either not informed on lime or who has been so fully informed on competing materials that he has misconceptions regarding the utility of lime.

"Many thousands of people saw the lime exhibited and several hundred took away to their respective places of business new ideas and information on the use of lime in their business gathered either from the literature of the association or from the personal discussions with its representatives.

"Whereas the inquiries at the exhibit last year had most to do with what lime is and its use in a general way, the inquiries this year had much more to do with how to begin the use of lime and where to get it. There is no doubt but that rapid, substantial progress is being made in getting the chemical industries to give more careful consideration to the use of lime along with competing products, with the result that lime is coming into greater use.

"The chemical uses of lime were featured at this year's exhibit, but due attention was also given to agricultural and construction uses. The inquiries about construction uses almost equaled those about chemical uses. While there is no doubt but that the exhibit will result in immediate sales of lime in each of the three fields, the main value of these expositions is their great effectiveness as a promotional agency which will have its effect upon lime tonnage for years to come."

Of the exhibit of the Talc and Soapstone Producers' Association, H. E. Boardman of the Eastern Talc Co., had this to say:

"The association represents some dozen producers in Vermont, New York, Maryland, North Carolina, Georgia, and California. Talc chemically is a hydrated silicate of magnesia and different deposits vary from a chemical standpoint according to the nature and amount of the impurities, no absolutely pure talc being found in a natural state. The great variations in talc are, however, much more physical than chemical; some deposits of the mineral take a distinctly fibrous form, others a micaceous form, and others a granular form; this means that, when pulverized, the particles retain a fibrous, micaceous, or granular shape, as the case may be, and this varied formation makes certain talcs particularly applicable for certain uses for which the other forms would be practically useless.

"The exhibition aroused a great deal of interest along these lines. We found that even among technical men the great differences in physical characteristics were little appreciated. The exhibit included some beautiful and unusual specimens which, while having no commercial value, served to emphasize the extreme variety in which the mineral Talc occurs.

"There were many inquiries as to the differences between talc and soapstone, the latter a very indefinie term either mineralogically or commercially, but perhaps soapstone may be defined as a very impure variety of talc running perhaps 40 to 50 per cent talc and the remainder consisting of various other minerals, the latter making it much harder than the talc alone, alhough it is talc in the soapstone which gives it its slippery feel and name."

St. Louis Meeting of Illinois Sand and Gravel Producers

THE Illinois Sand and Gravel Association held a meeting on September 28 at the Jefferson Hotel, St. Louis, the purpose of which was to hear the report of the representatives of the association who attended the priority order hearing before the Interstate Commerce Commission at Washington, September 21, at which time the commission heard the complaints of the sand, gravel and stone interests. The association was represented at the hearing by V. O. Johnston, H. A. Coffey, O. J. Ellingen and T. E. McGrath.

President Halliday suggested that the proposition of employing a paid secretary be discussed at the annual meeting. It was decided to give the matter further consideration at the next regular meeting.

Mr. Johnston advised that the National association will hold its constitutional convention at Chicago, November 15, at which time the new constitution will be submitted to the membership for adoption. It was agreed that a committee be appointed to represent the Illinois association at this convention. The next meeting of the association will be held at the Sangamo Club, Springfield, Ill.

The attendance: Carmichael Gravel Co., Danville; H. D. Conkey & Co., Mendota; H. H. Halliday Sand Co., Cairo; Lincoln Sand and Gravel Co., Lincoln; McGrath Sand and Gravel Co., Lincoln; Mississippi Lime and Material Co., Alton; Missouri Portland Cement Co., St. Louis; Moline Consumers Co., Moline; Neal Gravel Co., Mattoon; Peoria Washed Sand and Gravel Co., Peoria; Springfield-Pekin Sand and Gravel Co., Springfield; Western Sand and Gravel Co., Spring Valley; Beder Woods Sons Co., Moline; Yourtee-Roberts Sand Co., Chester.

President Appoints Coal Board

CONCRETE recommendations for accelerating distribution of coal were decided upon by the advisory committee on transportation, recently appointed by Federal Fuel Distributor C. E. Spens, at a conference held in Washington on September 6.

At the same time it was announced that President Harding has practically selected the seven members of the fact-finding commission created by Congress.

They are said to be: Oscar Straus, former Secretary of Commerce and Labor, of New York; John Hays Hammond of Washington, William B. Wilson of Blossburg, Pa., former Secretary of Labor; A. T. Hadley of New Haven, Conn.; W. L. Ripley of Newton Center, Mass.; Dr. Harry A. Garfield of Williamstown, Mass., wartime Fuel Administrator; John Brown, president of the Indiana Federation of Farm Bureaus; former Congressman T. H. Aldrich of Birmingham, Ala.; former Congressman James A. Hughes of Huntington, W. Va., and George O. Smith, director of the Geological Survey.

Details of the committee's recommendations are given in a letter to the executive heads of all the railroads by Chairman Daniel Willard.

Following are the recommendations:

Unload promptly all railroad material including railroad fuel.

Discontinue as far as possible all maintenance and construction work requiring the use of power and cars so as to turn this equipment into commercial service.

Use all available forces to check yards and stations for delayed cars with a view to securing prompt unloading and prompt movement.

Conduct an active campaign to have all cars loaded to their safe carrying capacity.

Point out to coal operators that available coal equipment can be increased by the avoidance of sales that require abnormally long distance movement.

Hauling Stone by Electric Cars

AS an interesting example of what may be accomplished by the transportation of crushed stone by an electric railway, General Manager R. R. Hayes of the Tiffin, Fostoria & Eastern Railway, has this to say in *Electric Railway Journal* for June 17:

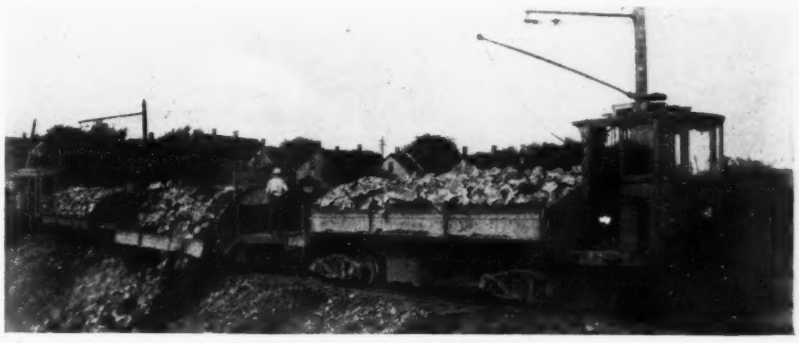
"Contracts were let for rebuilding roads paralleling our lines and connecting lines. The stone for this work could be secured from a quarry served by our lines as well as by the highways. As transportation by rail was cheaper than by steamer or motor truck, it seemed to be easy to get the contract for haulage at an extra margin of profit.

"As our equipment at that time did not include the proper rolling stock to handle the job, we purchased a Differential automatic dump car from the Differential Steel Car Co., Findlay, Ohio, which seemed ideal for this operation. In addition to its automatic dumping features, its method of placing the material away from the track was also advantageous. A two-way side-dump car was used which has many features not to be found in the older types. We were not only distributing the stone in the quantities specified by the contractor, but were able to handle a tremendous amount of material.

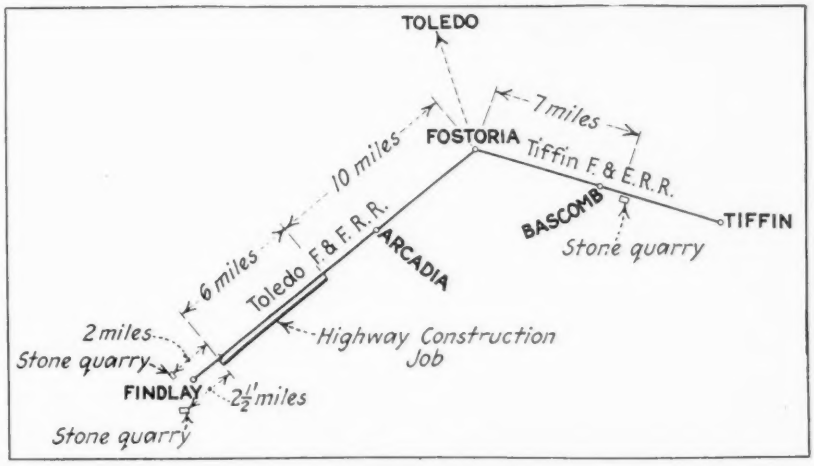
"Another interesting and profitable phase was our switching and delivering over our lines of more than 100 steam road cars of road-building materials, our Differential car serving as an electric locomotive. By varying the load in the car with the number and weight of cars to be hauled, we had a locomotive of from 25 to 50 tons."

The stone was hauled from three quarries at Findlay having similar equipment, so that the cost of stone was practically the same. While this stone was hauled by the railway some 20 miles, the contractor said that he saved some $10,000 by hauling the stone over the railway lines rather than by hauling it in motor trucks. The railway earned a profit of 86 cents per car-mile as compared with 14 cents for regular freight. The average load was 30 tons.

Judging from the foregoing experience, there is a chance for the quarry operator similarly located to see if the electric railway lines in his vicinity cannot handle his material at equally advantageous rates if the railway is similarly equipped. It certainly can be shown that this business can be made attractive to the railway and a rate made for the quarry that will not only make this form of transportation profitable to the quarry operator but help to solve the problem of car shortage and delayed delivery.



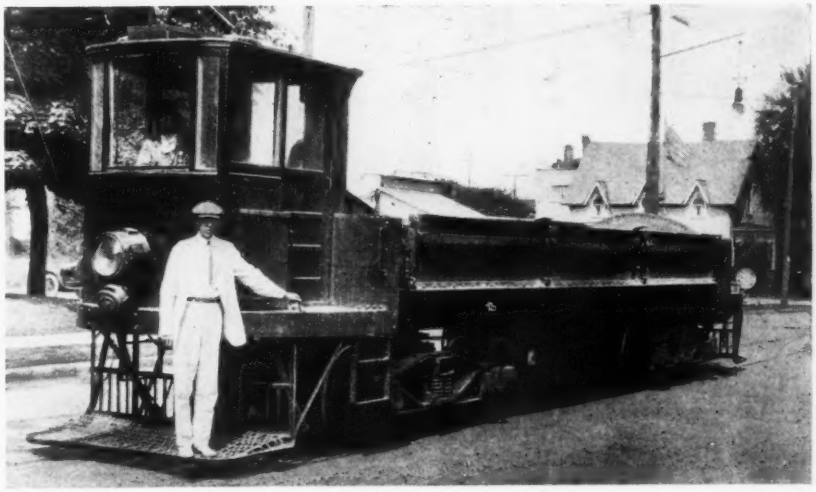
One of these automatic dump cars will unload 30 tons of crushed stone



Map of lines over which the stone was hauled

A Correction

IN the article entitled "How Burning Conditions Affect Lime," by James R. Withrow, in the September 9 issue of ROCK PRODUCTS, the name E. M. Ray should have been Emley. Mr. Withrow's initial was incorrectly given as H. instead of R.

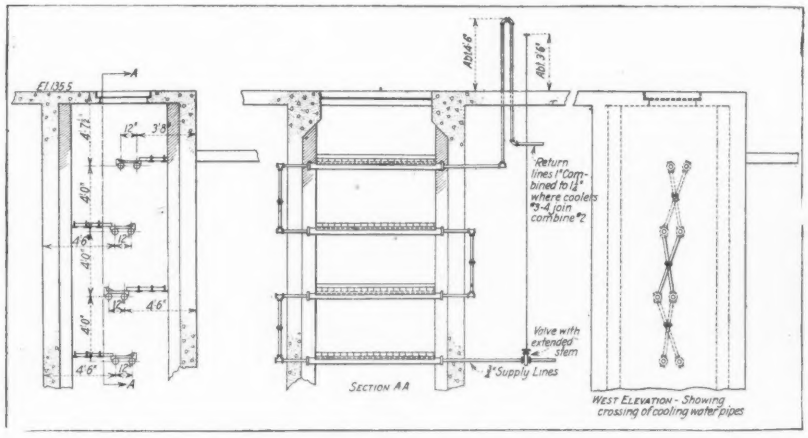


This is the type of car used by an electric railway to transport stone job quickly and at a profit

Hints and Helps for Superintendents

Cement Clinker Cooler

THE accompanying drawing shows a type of stationary clinker cooler that has been used with great success by a Western portland cement plant. The cooler is located at the discharge end of the kiln and consists of a rectangular concrete pit some 16 ft. deep. As is evident from the sketch, the cooler is provided with a system of water pipes through which fresh water circulates continuously.



Cross-section of stationary clinker cooler

As it is discharged from the kiln the hot clinker deposits itself on the first tier of pipes. As the angle of slope grows the clinker gradually falls to the second tier of pipes, then to the third and finally to the fourth, from which it goes to a bucket elevator depositing the clinker in storage. This type of cooler is said to be inexpensive and the clinker deposited at the clinker storage is thoroughly cooled.

Handling Coal from Storage to Boiler Room and Steam Shovels

IN many crushed stone, lime and cement plants it is often found advantageous to use that portion of the quarry which has been excavated as a coal storage. Of course, this depends more or less upon local conditions, and what might be good in one plant may not work out in another. The accompanying illustrations show a system that is used in a Western stone quarry.

The coal is dumped on the quarry floor, which is approximately 35 ft. below the surface level. The coal storage is approximately 3000 ft. from the boiler room, and a 24-ft. portable conveyor driven by a gasoline engine is used to load the coal. This conveyor can load to a height of 22 ft., 6 in. from the bottom of the coal pile. The conveyor discharges into a 6-yd. side-dump car mounted on a flat car and the dump car is securely locked on the flat car to keep it from moving. Thus when coal is needed in the boiler room, the dump car is filled and a small locomotive hauls it away. As the car approaches the boiler room the releases are unfastened and the coal is dumped direct into its pocket. The mounted car has sufficient height to clear the landings. No shoveling is necessary with this method.

System of coal handling used in a Western stone quarry

Again, when coal is needed by the steam shovels, the same apparatus is used. As the track is on the quarry floor, it is only necessary to switch the car and bring it to the spot where the shovel is. Here again the extra height brought about by mounting the dump car on the flat car is advantageous. The coal is simply unloaded in the coal pocket provided on the steam shovels. It is not necessary to dump the coal on the ground and then shovel it into the coal pocket.

Better Looking and Less Dangerous

USUALLY one of the most untidy parts of a plant is that around the crusher. Stone or gravel intended for the crusher will bound and scatter in all directions and clutter up the floor around the crusher opening, making the place look untidy and making it at the same time a more dangerous place, especially when round pieces of gravel get in the way to be walked upon.

Covering the crusher and the chute leading to it keeps this plant clean and removes the danger from flying stone and pebble-covered floors

All this is avoided at the Beloit plant of the Consumers Co., where D. C. Ellison, superintendent, has built a low wooden framework around the crusher

and covered over the opening with burlap and canvas. The chute leading to the crusher has also been covered with sheet metal, and the room which houses the crusher opening is now one of the cleanest spots in the plant. The illustration shows how both the chute and crusher opening have been covered and protected from flying stone.

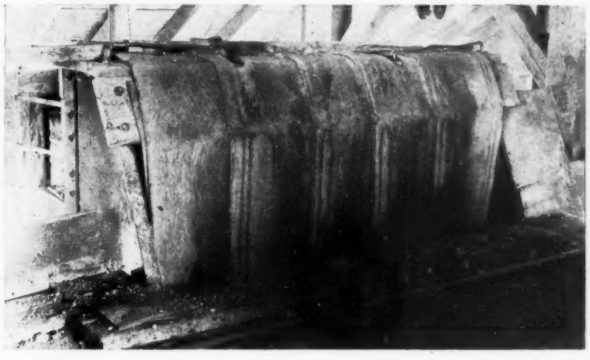
Curtain of Old Belting Prevents Accidents from Flying Rocks

ABOUT as good a use as any that can be made of scrapped and worn-out material is to employ it in the prevention of accidents.

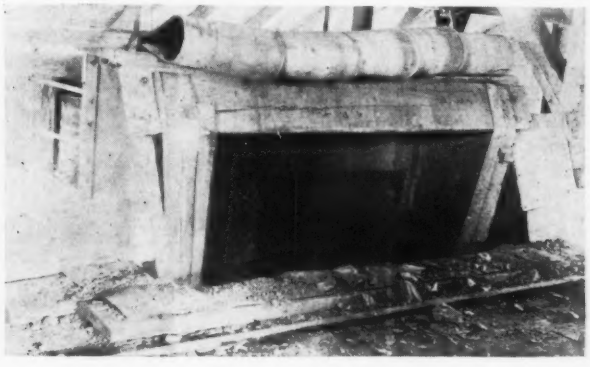
The accompanying illustrations show how one plant uses its worn out conveyor belts for this purpose. The belt is cut in pieces of the proper length which are hung to make a curtain at the top of a hopper into which the crushed rock falls.

Before this curtain was used accidents from flying rocks at this point were of common occurrence, and some of them were serious. Since the curtain was put in place the accidents from this cause have ceased.

One of the illustrations shows the curtain of old belting lowered, as it is while the crusher is running, and the lower cut shows the curtain thrown back over its support to give access to the space behind it.



Curtain made of old belting lowered while the crusher is running



When the curtain is thrown back to give access to the space behind it

Pit Selection of Material

EVERY gravel plant is sometimes confronted with the problem of meeting an extraordinary demand, at one time for sand, at another time for gravel of a certain size.

To make one it is, of course, necessary to make the others, and storage facilities for a variety of sizes are expensive. With a plant producing aggregates for city trade the problem is perhaps more pronounced than where a plant is making mainly road material or railway ballast.

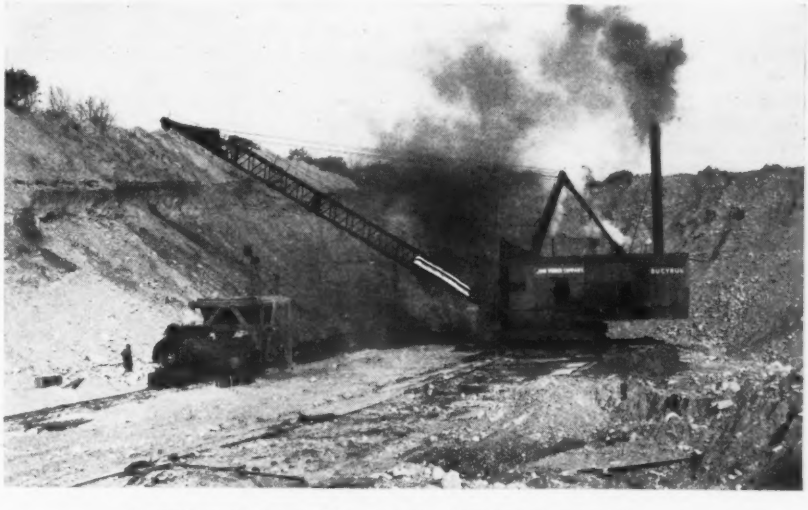
Even though the demand for material is constant the variations of the ordinary deposit of sand and gravel are so great that it would be impossible to maintain any kind of a fixed ratio in the production of finished products.

Some means of selecting the needed material in the pit are, therefore, highly desirable. A recent article described how this was done at one pit by means of a locomotive crane with a clam-shell bucket. The crane moved parallel to the bank and selected, as nearly as possible, the particular kind of material in most demand.

The view herewith shows another solution of the same problem. This view was taken at the gravel pit of the John Wunder Co., Minneapolis, Minn., where Mr. Wunder has replaced a steam shovel with a Class 24 Bucyrus drag-line excavator. This is one of the largest drag-lines on the market and its use in the manner described is certainly more or less unique.

The advantage claimed for this method of pit operation over the steam-shovel method is that the drag-line makes possible the selection of material over a wide area with no moving of machine or equipment.

The steel boom is 100 ft. long and the scraper bucket holds 3½ cu. yd. Ordinarily a drag-line like this would not be used to dig into the face of a high bank, but in the case of a naturally clean, dry gravel the bank will fall in fast enough to provide ample material for the bucket for a long time. Moreover, this device can dig to about 30 ft. below grade, at the same time it is eating away the bank.



A solution of the problem of pit selection of material

Trees Instead of "Dead-men"

AT THE plant of the Western Sand and Gravel Co., at Spring Valley, Ill., the back line is stretched between two large trees. Although the trees are farther away from the operation than necessary, they are preferable, insofar as this method eliminates labor and expense in digging for dead-men.

Quarried from Life

By Liman Sandrock

How's YOUR Health?

JUST suppose that you or I had so labored in the rock products vineyard that the family doc up and told us: "Drop everything, Cuthbert, and take a year's rest—or you'll soon be clasping a pale lily in your alabaster hand and there'll be a new man on your job." What would we do? Take unto ourselves a nifty 100-ton motor yacht, and a friend or two, and up anchor for the end of the world? Perhaps—and mebbe not.

A year ago last August, A. Y. Gowen, vice-president of the Lehigh Portland Cement Co., of Chicago, brought to fruition his long cherished ambition to make a world cruise in his own cruiser. And his poor health offered every excuse for telling dull Care to go hang.

ROCK PRODUCTS' news pages related the story of Mr. Gowen's trip in its issue of July 2, 1921, and from time to time we heard from him. Now his secretary, C. C. Carlsen, says that his yacht, the "Speejacks," is today in the troubled waters of the Mediterranean, where Mustapha Kemal and our British cousins are wrangling over keeping the Dardanelles straight and the unspeakable Turk equally so.

As at present planned, Mr. Gowen and his party will visit Athens, Messina, Marseilles and Gibraltar, whence the travelers will sail for God's country on October 15 by the Southern course. They hope to meet up with the Goddess of Liberty about the first of December, having visited the Canary and Cape Verde islands, Porto Rico and Miami, Fla.

Say, wouldn't you be almost tempted to deliberately ruin your own health if you could afterward get such a prescription filled?

Of course, Mrs. Gowen is an honored member of the party, as well as Bernard Rogers, Jr., a Chicago insurance man, who will have opportunity to judge at first hand if the Prudential has anything on the original Gibraltar rock. Brother Ingraham, also a guest, is a noted movie camera man, and what he has already gathered for the silver screen should some near day make mighty interesting material for an evening's entertainment.

Experiences? Indeed they had. For 22 days the gallant little "Speejacks" was towed on the Pacific for lack of gasoline. The Standard and the Sinclair chaps have neglected to install service stations in Balboa's well-known waterway, and no hundred-ton yacht has the capacity for gas to carry it that distance. Again, on reaching India there was propeller trouble, so during the repairs the party neighbored about the historic places and got their sea legs corrected.

Fifty thousand miles of unalloyed delight without a tire trouble. Gosh, how we'd love it! If some kind friend would only tell Nate Rockwood or George Miller that, in order to hold us—our present health is only 1 per cent tolerable—they must fit us out

Skipper Gowen of the "Speejacks"

with a speejacks and— No, we'll probably keep pegging away until we become a lily-clasper, and then, more than likely, they'll hire another boy.

Brother Gowen, while you have created envy and discontent within us, we're still wishing you a safe return to our shores and all the health you can hold.

That Newmans Bridge "Mulligan"

O mulligan stew! O mulligan stew!
We know it—we love it! How about You?

FROM the *Marion Excavator* we learn that the Marion Steam Shovel Co. recently entertained its cost and production departments at Newmans Bridge with a mulligan stew. If you, gentle reader, do not know of the delights of that delectable dish, you've missed something. Nothing will put such pep, the go-get-it spirit, into you, if you are going stale and unprofitable, as the aforesaid stew.

Marion's reason for this party was to fatten up Joe Bauman, Bill Cresap, Sam Bader and Bun Houghton. This "bun" has no relation to "stew" in its ordinary acceptation.

This is the crew: Two onion peelers, 2 potato slicers, 2 cabbage cutters—and 25 anxious waiters. First prize went to Edmondson as the longest eater; the second to Cleveland as the best woodchopper; third, to the poorest fisherman—which was a tie; the fourth, the best onion peeler—also a tie, as Yock Sweeney peeled his thumb as well.

The next annual contest will be the roasting ear vs. the wienie. The wienie should win by four barks, doggone it, if the tights hold out and do not bag at the knees.

They Said It!

GEE, but our industry is taking hold! Here's a guy says he's so hard-boiled that he shaves with a blow-torch, and eats cement, rocks, and plate glass.

THEN, there's that British chemist who says we can all live to be 175 years old if we scientifically potash ourselves, and we can grow new hair, and teeth—and everything. Mebbe, we will then have cars aplenty, too, and coal to burn.

HERE'S ANOTHER ONE: The *Kankakee Daily News* says: "Gravel falls on second session of 67th Congress." Just think what would fall on the I. C. C. if we had our way. Suggestions are invited.

ONCE MORE! Ol' Doc Cement has filled a huge cavity in a New Jersey red oak, using half a ton of his well-known filler. A 560-lb. man is said to have thrown a limb over a leg of this tree and the said leg never kicked.

QUERY? Does any brother know of a budding genius who is studying the elimination of the giveaway rim on the pint bottle's bottom that reflects the moonshine on the moonshine? Oh, for one—one genius, that is.

"THE STORY OF SAND," as suggested by the *National Sand and Gravel Bulletin*, may be the title some day of a movie film. We will be found in the front row, provided Mack Sennett does not lug in his bathing beauties. In any event, we may still sit in the said row.

IT IS SAID that a bottle was recently found in Turkish sands containing these words: "I. Mustapha Drinc." One is curious to know if this is merely a signature—or a frantic plea.

BEN PICKLE, a Warrensburg, Mo., quarry owner, is as sour as vinegar over the threat of the railroad to remove its tracks from his plant. Ben has evoked the 57 varieties of the law to bring him redress. Atta boy, Heinz!

Editorial Comment

Lime and Paleontology

How many lime manufacturers know what paleontology is? How many of them know that paleontology probably has a very important bearing on the future of the lime industry? For in burning limestone to make lime certain definite properties are aimed at in the finished product, whether the product is for use in plaster or mortar, or in some chemical industry. The attainment of those properties as lime is at present manufactured in almost entirely a hit-and-miss method. No one has yet satisfactorily explained why certain limestones give resulting limes of peculiar properties while other limestones of practically the same *chemical composition* do not. Through paleontology is opened a logical explanation of these differences.

Paleontology is "the science of the former life of the earth; the study of life of former geological periods; that branch of biology which treats of fossil organisms, and especially of fossil animals." Limestone is nothing more or less than deposits of calcium and magnesium carbonates formed by plants and animals which formerly lived on the earth or in its waters. There were thousands of varieties of plants and animals which had the property, or the ability, to precipitate calcium and magnesium carbonates out of the water in which these minerals were dissolved, to form grains and shells or bones of lime carbonate which eventually became cemented together as limestone.

It requires no great stretch of the imagination to see that the character of the limestone deposited must have been profoundly affected by the kind or variety of plant or animal whose fossil remains form the deposit, for the physical and chemical structure of microscopic plants vary just as much as do present-day trees and quadrupeds. The differences in physical structure, of course, are far more pronounced than the chemical differences. The chemical elements in the body of a horse and of an elephant probably do not vary much in their character and proportions, but the physical differences of the two animals are certainly huge. Similarly, there is not much difference in the chemical composition of the various hardwoods, yet their physical differences and properties are very great. Limestones may be compared on a like basis.

It is logical to believe that two limestones formed by the deposit of the same species of organism will have the same properties; that under the same conditions in the kiln they will produce lime with the same properties. It has long been known that chemical analyses alone formed a very poor guide as to the behavior of two different limestones in a kiln, or of the character of the lime produced. On the other hand, there has been no accurate standard of comparing the *physical* properties of limestones. Hence, a knowledge of geology and paleontology opens the way to accurately classifying every limestone, so that it can be compared with another, just as various species of mosquitoes are compared, or various kinds of apples.

It would seem that this is the first step in attaining any real knowledge of the properties of lime and how they may be obtained from limestones. For by such means the various limestones in a single quarry may be identified and studied, as ROCK PRODUCTS will demonstrate in a subsequent article describing how this very thing has been done, and what it means to the future of the lime industry.

What's Your Sand Worth?

Much sand is being sold today at 75 cents a ton which might be selling for twice and in some cases five times that amount. It is a question of knowing what your sand is good for and finding the right market. Some sands have particular properties which make them especially valuable for certain uses where much higher prices can be paid than for other uses. The more that is known about the properties of various sands the more would be the value of those having special qualities over ordinary sands. If you really know all about your sand you may be able to market it more advantageously than you are doing at the present time as "just sand."

It is important to notice in this respect that the American Foundrymen's Association has been paying considerable attention to research in molding sand. A special session of this association was devoted to this subject at the annual convention this year.

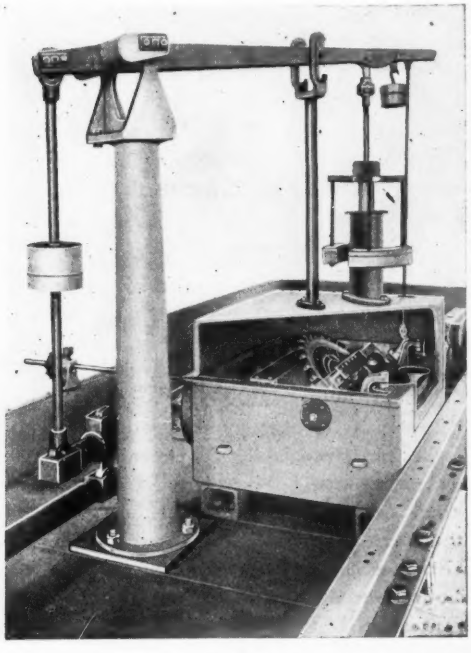
Another sand which is in much demand for a special purpose is engine sand. It is used by railroads, street railways and in mines for sanding the rails under locomotives. Most any sand plant which produces a sand of silicious origin can turn out engine sand, if sufficient care is used in the separation. The same is true of many other special sands, such as "asphalt" sand.

A thorough study of the chemical and physical properties of various kinds of sand ought to benefit sand producers who can use the knowledge thus gained in selecting sands with the special qualifications needed for special and higher priced uses. At the present time sands are too much on the same basis because of the lack of standards by which to judge their values, and the investigations now under way should react to the profit of many sand producers.

New Machinery and Equipment

Weighing Bulk Material in Transit Over Conveyors

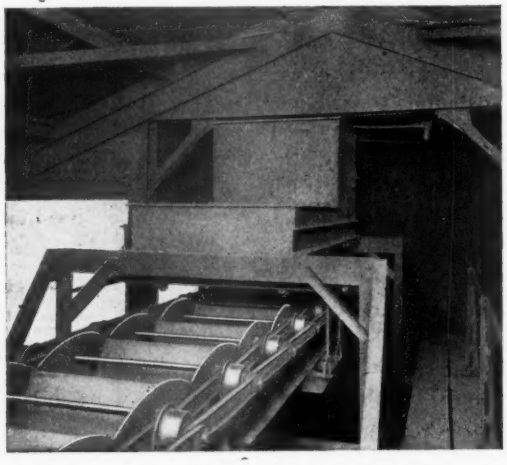
CEMENT-MILL managers and all rock-products engineers and operators consider conveying equipment essential for efficient management and operation on account of labor and time saved. It is just as essential in most cases, claim the Merrick Scale Mfg. Co., Passaic, N. J., to have a record of the weights delivered either at the crushing, the calcining or finishing ends of the cement manufacture. It is particularly advantageous when the weights can be obtained without interrupting the handling of the rock, shale, clinker or cement in any way.



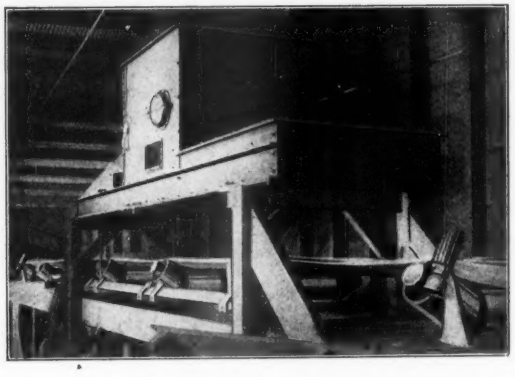
The weigh beam standard fulcrum bracket and integrator box, with part of cover cut away to show details of construction

The Merrick conveyor weightometer is an automatic scale which mechanically weighs and records the weight of all material passing in transit over a belt, bucket or pan conveyor. This weightometer carries a portion of the moving belt suspended from its levers. Driven by sprockets and chain from the return side of the belt, the weightometer automatically totals the weight upon a continuous automatic counter that passes over the suspension and eliminates the services of a weighman.

No motor, generator or other outside attachments are necessary. The scale is shipped as a complete unit and to put it in operation all that is required is to install it over the conveyor upon simple supports of either angle iron or timber, connect up a small sprocket and the scale accomplishes the rest and does the weighing with a guaranteed accuracy of 99 per cent of the true weight.



Installation of conveyor with weightometer on a pan conveyor



Typical installation of Merrick conveyor weightometer on belt conveyor

Many installations, say the makers, have been made in the cement field, weighing rock, shale, sand, gravel, stone, finished cement, coal and the hot or warm clinker.

The company states that 80 per cent of the installations are made by the users themselves by the aid of a complete set of printed instructions and with accompanying photographs.

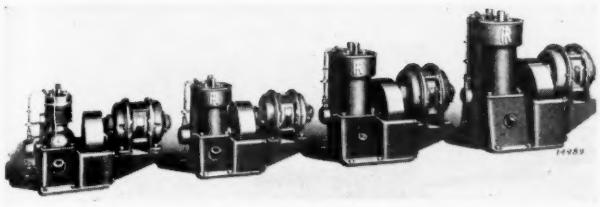
New Small Vertical Belt Driven Air Compressors

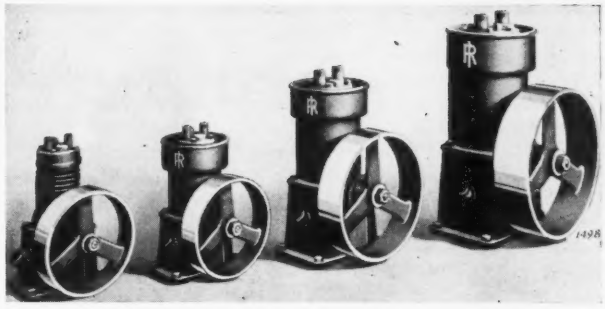
A NEW line of small vertical belt driven air compressors known as Type Fifteen is announced by the Ingersoll-Rand Co., 11 Broadway, New York. In addition to the plain belt drive design each size is built as a self-contained electric motor outfit, driven through pinion and internal gears, or by employing the short belt-drive arrangement. The compressing end and electric motor of both gear and short belt-drive units are furnished mounted on a common subbase, so that they are in no way dependent upon the foundation for correct alignment.

Several noteworthy features have been incorporated, including a "constant-level" lubrication system, the constant speed unloader for plain belt drive machines, the centrifugal unloader for start and stop control machines and the increased size of the water reservoir cooling pot.

The "constant-level" system used in Type Fifteen compressors automatically maintains a constant-level of oil, which insures the right amount being distributed to all parts.

The base of the compressor forms an oil reservoir for the "constant-level" system; pet cocks determine the maximum and minimum amount of oil in the reservoir. Above this reservoir and directly underneath the connecting rod is a constant-level pan. Oil is pumped from the reservoir into this constant-level pan through a unique oil pump. Regardless of the amount of oil in the reservoir, so





Vertical electrically gear-driven air compressors, showing air-cooled and water-reservoir-cooled machines. To the right, vertical belt-driven air compressors

long as it is somewhere between the high and low level pet cocks, this system insures a constant-level of oil in the pan. A projecting stem on the connecting rod dips into this pan and distributes sufficient oil for proper lubrication.

The constant speed unloader controls the unloading of the compressor by automatically opening the inlet valve when the receiver pressure rises above that at which the unloader is set to operate. When the receiver pressure has fallen a predetermined amount, the unloader automatically releases the inlet valve and allows the compressor to return to work, again building up the pressure.

The centrifugal unloader allows the compressor to start under "no load" and permits the electric driving motor to come up to full speed before the load is thrown on automatically. This unloader holds the inlet valve open until the motor has reached full speed.

A New Bucket Loader

THE latest type of bucket loader put on the market by the James B. Seaverns Co., Chicago, is shown in the accompanying illustration. This large and powerful loader, says the manufacturers, has a chute measuring nearly 10 ft. above the road, this allowing the largest trucks to be loaded to full capacity without any necessary trimming with a shovel at the cab end of the body.

This chute height permits the truck to back up with the loader as it drives its way into the pile, allowing the material to flow by gravity and burying the buckets, thereby making it unnecessary for any mechanical feeding devices.

The power plant consists of a 15-hp. electric motor (and 20 hp. when driven by gasoline motor), back geared with heavy cut spur gears driving to countershafts by steel roller chains. There are but two friction clutches, one driving the buckets, the other for propelling. The reverse and differential gears are both self-contained in a heavy cast-iron housing, insuring perfect alignment and uniform wear at all times.

The main frame is exceptionally strong, being built of heavy structural steel shapes and plates with plenty of diagonal braces to withstand the unseen strains of "cave-ins" or hard digging. All gears and sprocket wheels are of electric steel, carefully heat treated. The main chains carrying the buckets are extra heavy, having 1-in. diameter pins. The buckets are of malleable iron, spaced every foot. All parts are made on the duplicate part system—parts are interchangeable.

Bucket loader with chute 10 ft. above the road

Motor Truck Mounting for Crane

A BIG forward step in "taking the crane to the job" has been made, claim the Byers Machine Co., Ravenna, Ohio, in bringing out a crane that can be mounted permanently on a motor truck. The new outfit, the Byers Truckrane, can be driven from the garage to the job every morning, or driven from one job to another with a minimum of lost time.

Owners whose work has hitherto been too limited to operate a large crane, can, it is believed, use a machine of the "Truckrane" type at a profit.

Unmounted, the crane weighs only six tons, and is similar to the Byers autocrane Model No. 1, except that it has no wheels, jack shaft, nor differential and drive chains. It has a power drum for

Taking the crane to the job

raising and lowering the steel boom. The crane is furnished with a Hercules four-cylinder, 4x5-in. engine developing over 30 hp., to be operated with gasoline power. Any half cubic yard bucket weighing not over 2000 lb. can be used with it.

It is not necessary to use a new truck for the mounting. One that has seen 90 per cent of its usefulness, having a motor capable of turning over, is all that is needed. Bargains in half-worn out motor trucks can be had everywhere, making the first cost of a complete outfit extremely reasonable.

New Type of Chain for Cement Mill Service

A NEW chain has been designed by the Chain Belt Co., Milwaukee, Wis., primarily for service in cement mills. This is an all-steel chain which is adapted for service in other industries as well as cement mills, but it is particularly adapted for the latter.

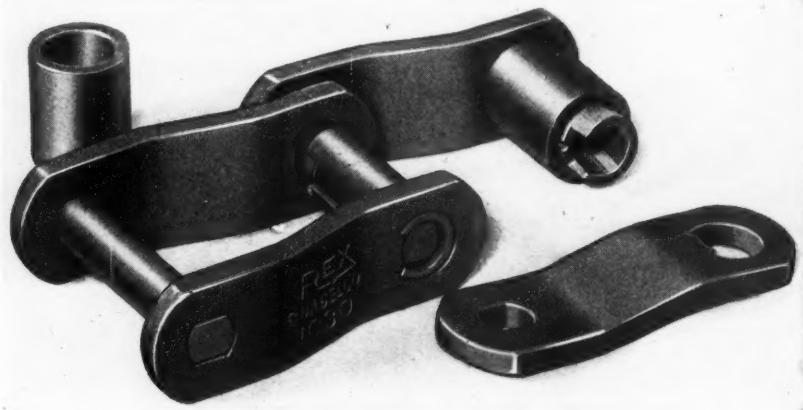
The so-called "positive drive" came into being in the form of malleable detachable chain about 50 years ago, and one of the most popular sizes was No. 103. As the chain business grew with the demand of the trade there was finally placed on the market a heavier type of chain, also made of malleable iron, and generally known as the pintle type. This latter chain was made in the popular sizes, such as No. 103, and it was found superior to the detachable type because of its heavier construction and improvement in design.

A great many cement mill operators found that their need for heavier and stronger drive chains was increasing and that in many cases the malleable type of either detachable or pintle chain was inadequate. Therefore, the chain manufacturers gradually worked into all-steel chains, and for a time it looked as though the drive problem was solved. While the all-steel chains are found to be generally satisfactory for most purposes, the cement mill users have frequently objected to it because of the abrasive wear that takes place between the roller and bushing.

It was at this point that the manganese detachable chain manufacturers actively entered the field. The advantage of the manganese detachable chain over steel lies primarily in the fact that in the case of the former there is less wear due to abrasion, and the further fact that manganese is a strong substance made it possible for this type of chain to make inroads on the steel chain business as far as cement mills are concerned.

The new chain, the company claims, will mark a still further change in the marketing of drive chains for cement mills, and it bids fair to supplant manganese, first because of its wearing qualities, and second, because it can be marketed at a lower price than manganese.

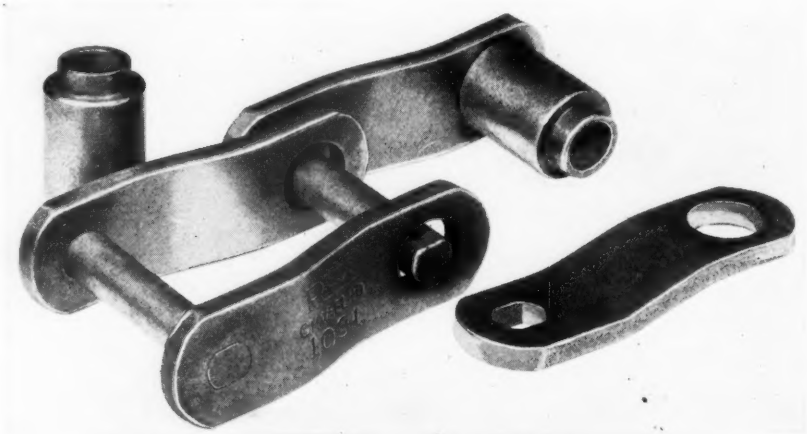
This chain is known as No. 1031 Rex Chabelco, and it is designed to fit the No. 103 wheel. It is a further development on the 1030 Chabelco chain. No. 1030 steel bushed roller chain is made up of high carbon steel side bars. The rollers are made of high carbon open hearth steel stock, machined and heat treated. The bushings are formed from cold rolled steel and are case-hardened. The pins are made of hot forged steel, rolled smooth after forging, and case-hardened. This case is approximately 3/32 in. deep. The end of the pin is milled flat on two sides to insure a drive fit in the broached slotted hole in the side bar. This prevents rotation of the pin and distributes the wear to the large pin and bushing areas. No. 1030 chain embodies many desirable features, but its use is objectionable to some cement mill users because of the excessive wear due to abrasion which takes place between the roller and bushing. The problem therefore was to design a steel chain which would embody the commendable features of No. 1030, but eliminate the one above mentioned which makes for abrasive wear.



Original type of steel bushed roller wherein the bushing and roller are separate units and subject to the action of grit

Chain No. 1031 was finally designed and a number of drives have been in operation for test purposes during the last year with excellent results. This new chain is identical with 1030 except that instead of having a roller and bushing it is equipped with a combination roller and bushing, the outside diameter being the same as the roller on No. 1030. This unit is made of high carbon, open-hearth steel stock, and is heat treated on all surfaces for wearing quality. It is turned down at the ends to permit of a drive fit in the broached holes of the side bar. These side bars are made of high carbon steel from .35 to .45. The pin likewise is case hardened steel, and has a swelling under the head to insure a drive fit in the side bar. This chain is furnished both in the riveted and pin and cotter style.

The new type of chain is also applicable to lime, gypsum, phosphate, sand and gravel, crushed stone and other non-metallic industries where excessive wear on drive and conveyor chains, due to abrasion which takes place between roller and bushing, are found.



The new Chabelco No. 1031 has the roller and bushing in one unit to avoid destructive action of gritty materials

Accident Prevention

Protcetion of Quarry Laborers from Falls of Material

ROLLING stones may not be moss gatherers, but they surely collect their toll of human bark. Every year rolling and falling stones cause needless misery to hundreds of quarry workmen. Reducing this class of accidents should be the objective of every quarry operator, for accidents from falling material annually total 15.2 per cent of all quarry accidents reported. It is a field in which very little can be done in the way of installing or applying safeguards, but a great deal can be done by the exercise of constant care. Nowhere is the slogan "Eternal vigilance is the price of safety" more fully true. In no other class of accidents is carelessness so large a factor.

There are two rules which, if made mandatory, will bring a surprising reduction in accidents of this type. These are, "Tunneling in earth should not be and will not be allowed in the future," and "The rule requiring men to use shelter houses during blasts should be more rigidly enforced, and will be in the future." As long as the amount of care to be exercised is left to the judgment of the individual workman, accidents will be frequent. Just so soon, however, as it becomes an important part of the duties of each foreman to see that every man under him does his work in a safe manner, and keeps the rock around him safe, there will be a very material reduction both in number and in seriousness of accidents from this cause.

Among the more common of rock and stone accidents are the following: rock flying from rock or hammer, rock falling or rolling from face of bank, top of bank, pile, quarry, skip, overhead in building, elevators, and roof of mine.

After a big shot, the quarry foreman should go over the entire top and face of the bank and examine it with great care. All loose rocks should be thrown down from the top of the bank, and from as much of the face of the bank as can be reached; if there is any left in a threatening position, the men should be kept away from under it. Following this, the foreman should inspect the face of the bank thoroughly at least twice each day, especial attention being given to places where men are removing rocks from the core of the bank.

Materials can be easily prevented from falling from loaded cars or skips by proper supervision being exercised by the foreman. If the foreman keeps a watchful eye on the manner in which skips and cars are loaded, he can often correct careless loading, in which rocks overhang the edge of the car or skip.

One of the common causes of accidents in loading cars is the breaking of a rock while it is being lifted into a car. This cannot always be foreseen, but the exercise of ordinary precaution should have an effect in reducing this hazard.

Materials falling from elevated points in buildings or from trestles, fall in a class of accidents that are usually preventable by careful housekeeping. The position of toeboards and the filling in of floors, platforms, trestles, etc., are important aids in preventing such accidents.

Rocks and earth slides offer possibilities of accidents of the most serious type. An overhanging bank is a danger to workmen engaged below and no experienced quarry foreman, if he takes his responsibility to heart, will allow men to work under an overhanging ledge. Clumsy workmen should never be allowed to pry down loose rocks. There is always the chance of a broken leg from a sliding rock and it is only the careful workmen who will foresee the danger. Men should be taught to keep clear and in a position from which they can move quickly in case of necessity.

One of the most common causes of accidents in quarries is a stone rolling on a man's finger while he is lifting another stone near it. The remedy is principally one of constantly urging men to be careful and then seeing that they obey orders. Rock being moved from the bank should be moved with bars until they are entirely free and supporting no other rock. Rocks in cars should be placed firmly so that they will not roll. When more than one man is loading a car, each should be careful of the other, and should not work too close to him. Where there is sufficient room, there should be a car to each two men.

Rock flying from blasts has been responsible for many injuries in the past, some of them serious. The majority of injuries from "dobe" shots or block-holing, and are the result of men not going far enough away from the block or not seeking proper shelter. The remedy is the provision of a sufficient number of shelter houses and absolute enforcement of their use. It is usually easy enough to have all blocks and "dobe" shot fired at noon, or at some time when it will not work a serious hardship to have all the men within range stop work.

A difficult problem is that of chips flying from rocks or from hammers when breaking rock. Eye injuries are most common from this cause. The same procedure here which is used in all industries where there is an eye hazard, is the answer. Require that men doing this work wear goggles. The men breaking rocks should be separated as much as possible so that chips from one man's hammer will not strike a neighboring workman.

The Rock Products Market

Wholesale Prices of Crushed Stone

Prices given are per ton, F. O. B., at producing plant or nearest shipping point

Crushed Limestone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:						
Blakeslee, N. Y.	1.00	1.25	1.10	1.10	1.10	.....
Buffalo, N. Y.			1.30 per net ton all sizes			
Chaumont, N. Y.	1.00	.....	1.50	1.25	1.25	1.25
Cobleskill, N. Y.	1.25	1.25	1.25	1.25	1.25	.....
Coldwater, N. Y.			1.50 per net ton all sizes			
Eastern Penna.	1.35	1.35	1.35	1.35	1.35	1.35
Munns, N. Y.	.75	1.15	1.15	1.15	1.15	1.15
Prospect, N. Y.	.75	1.25	1.25	1.25	1.25	.....
Walford, Pa.	.....	1.30	1.30	1.30	1.30	1.30
Western New York	.75	1.20	1.20	1.20	1.20	1.20
CENTRAL						
Alton, Ill.	1.50	.....	1.50	1.35	1.35	.....
Buffalo, Iowa	.90	.....	1.20	1.00	1.05	1.10
Chasco, Ill.	1.30	1.25	1.25	1.25	1.20	.....
Chicago, Ill.	1.30	1.70	1.30	1.30	1.30	1.30
Dundas, Ont.	1.00	1.35	1.35	1.25	1.10	1.10
Faribault, Minn.	.....	.....	.....	.....	1.75	.....
Greencastle, Ind.	1.25	1.00	.90	.90	.90	.90
Kansas City, Mo.	1.00	1.50	1.50	1.50	1.50	1.50
Krause, Columbia and Valmeyer, Ill.	1.40	1.35	1.35	1.35	1.20	1.20
Lannon, Wis.	.80	.....	.95	.85	.85	.85
Mitchell, Ind.	.80	.80	.80	.80	.80	.80
Montreal, Canada	.80	1.35	1.05	.95	.90	.....
Montrose, Ia.	.....	1.50	1.60	1.55	1.45	1.40
River Rouge, Mich.	1.00	1.10	1.10	1.10	1.10	1.00
Sheboygan, Wis.	1.10	1.10	1.10	1.10	1.10	.....
Southern Illinois	1.35	1.25	1.25	1.25	1.10	.....
Stolle, Ill. (I. C. R. R.)	1.30	.....	1.35	1.35	1.35	1.35
Stone City, Iowa	.75	.....	1.40	1.30	1.25	.....
Toledo, Ohio	1.60	1.70	1.70	1.70	1.60	1.60
Toronto, Canada	1.90	2.25	2.25	2.25	2.00	2.00
Waukesha, Wis.			Prices include 90c freight all sizes .80 per ton			
SOUTHERN:						
Alderson, W. Va.	.75	1.25	1.40	1.25	1.15	.....
Bromide, Okla.	.75	.....	.....	1.50	1.50	.....
Cartersville, Ga.	.....	2.00	2.00	1.40	1.40	1.40
Chickamauga, Tenn.	.75@1.00	.75@1.25	.....	.75@1.00	.75@1.00	.....
Dallas, Texas	1.00	1.00	1.00	1.00	1.00	1.00
El Paso, Tex.	1.00	1.00	1.00	1.00	1.00	.....
Ft. Springs, W. Va.	.60	1.25	1.40	1.35	1.20	.....
Garnet and Tulsa, Okla.	.50	1.60	1.60	1.45	1.45	.....
Ladds, Ga.	.....	.....	1.40	1.40	1.40	.....
Morris Spur (near Dallas) Tex.	1.00	1.40	1.35	1.30	1.25	1.20
WESTERN:						
Atchison, Kans.	.50	1.80	1.80	1.80	1.80	1.80
Blue Springs and Wymore, Neb.	.20	1.65	1.65	1.55	1.45	1.40
Cape Girardeau, Mo.	1.50	.....	1.50	1.50	1.25	.....
Kansas City, Mo.	1.00	1.50	1.50	1.50	1.50	1.40

Crushed Trap Rock

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Bernardsville, N. J.	2.00	2.20	2.00	1.80	1.50	.....
Branford, Conn.	.60	1.50	1.25	1.05	.95	.....
Bound Brook, N. J.	1.80	2.30	1.90	1.50	1.40	.....
Dresser Jct., Wis.	1.00	2.25	.....	1.75	2.00	.....
Duluth, Minn.	.90@1.00	2.00@2.25	1.75@2.00	1.40@1.50	1.30@1.40	1.50
E. Summit, N. J.	2.10	2.30	2.00	1.70	1.40	.....
Eastern Massachusetts	.60	1.85	1.40	1.40	1.40	1.40
Eastern New York	.75	1.50	1.30	1.30	1.40	1.40
Eastern Pennsylvania	1.15	1.50	1.45	1.35	1.30	1.30
New Britain, Middlefield, Rocky Hill, Meriden, Conn.	.60	1.35@1.45	1.15@1.25	1.05	.95@1.00	.....
Oakland, Calif.	1.75	1.75	1.75	1.75	1.75	1.75
Richmond, Calif.	.50*	.....	1.50*	1.50*	1.50*	.....
Springfield, N. J.	2.00	2.10	2.00	1.75	1.60	1.60
Westfield, Mass.	.60	1.35	1.25	1.10	1.00	.....

Miscellaneous Crushed Stone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Buffalo, N. Y.—Granite	.90	.....	1.20	1.00	1.05	1.10
Berlin, Utley and Red Granite, Wis.	1.50	1.60	1.40	1.30	1.30	.....
Columbia, S. C.—Granite	.....	.....	1.75@2.00	1.75	1.60@1.75	.....
Dundas, Ont.—Limestone	1.00	1.35	1.35	1.25	1.10	1.10
Eastern Penna.—Sandstone	.85	1.55	1.55	1.40	1.35	1.30
Eastern Penna.—Quartzite	1.20	1.30	1.20	1.20	1.20	1.20
Lithonia, Ga.—Granite	1.00	2.50	2.00	1.25	1.25	1.00
Lohrville, Wis.—Cr. Granite	1.35	1.40	1.30	.....	1.20	.....
Middlebrook, Mo.—Granite	2.50@3.50	.....	2.00@2.25	2.00@2.50	.....	1.50
San Diego, Calif.	.50@ .70	1.45@1.75	1.40@1.70	1.30@1.60	1.25@1.55	1.25@1.55
Sioux Falls, S. D.—Granite	1.00	1.60	1.55	.....	1.50	.....

*Cubic yard. †Agrl. lime. ||R. R. ballast. §Flux. ‡Rip-rap, a 3-inch and less.

Agricultural Limestone

EASTERN:

Chaumont, N. Y. — Analysis, 95% $CaCO_3$, 1.14% $MgCO_3$ — Thru 100 mesh; sacks, 4.00; bulk	2.50
Grove City, Pa.—Analysis, 97% $CaCO_3$ —100% thru 20 mesh, 60% thru 100 mesh, 40% thru 200 mesh; in 80 lb. paper sacks, 4.50; bulk	3.00
Hillsville, Pa. — Analysis, 96.25% $CaCO_3$—Raw ground; sacks, 4.50; bulk	3.00
Jamesville, N. Y. — Analysis, 89.25% $CaCO_3$, 5.25% $MgCO_3$; pulverized limestone; sacks, 4.00; bulk	2.50
New Castle, Pa.—89% $CaCO_3$, 1.4% $MgCO_3$—75% thru 100 mesh, .84% thru 50 mesh, 100% thru 10 mesh; sacks, 4.75; bulk	3.06
Walford, Pa.—Analysis, 50% thru 100 mesh; 4.50 in paper; bulk	3.00
West Stockbridge, Mass., Danbury, Conn., North Pownal, Vt.—Analysis, 90% $CaCO_3$—50% thru 100 mesh; paper bags, 4.25—cloth, 4.75; bulk	3.00

CENTRAL:

Alton, Ill.—Analysis, 97% $CaCO_3$, 0.1% $MgCO_3$—90% thru 100 mesh	6.00
50% thru 50 mesh	4.00
Bedford, Ind. — Analysis, 98.5% $CaCO_3$, .5% $MgCO_3$—90% thru 10 mesh	1.50
Belleville, Ont. — Analysis, 90.9% $CaCO_3$, 1.15% $MgCO_3$—45% to 50% thru 100 mesh, 61% to 70% thru 50 mesh; bulk	2.50
Bellevue, Ohio — Analysis, 61.56% $CaCO_3$, 36.24% $MgCO_3$; ¼ in. to dust, about 20% thru 100 mesh	1.2[illegible]
Bettendorf, Ia., and Moline, Ill.—97% $CaCO_3$, 2% $MgCO_3$—50% thru 100 mesh; 50% thru 4 mesh	1.25
Buffalo, Ia.—90% thru 4 mesh	1.00
Cape Girardeau, Mo. — Analysis, 93% $CaCO_3$, 3.3% $MgCO_3$—50% thru 100 mesh	1.50
90% thru 4 mesh, cu. yd.	1.35
Chicago, Ill.—Analysis, 53.63% $CaCO_3$, 37.51% $MgCO_3$—90% thru 4 mesh	1.00
Columbia, Ill., near East St. Louis—½-in. down	1.25@1.80
Detroit, Mich.—Analysis, 88% $CaCO_3$, 7% $MgCO_3$—75% thru 200 mesh, 2.50@4.75—60% thru 100 mesh	1.80@3.80
Elmhurst, Ill. — Analysis, 35.73% $CaCO_3$,, 20.69% $MgCO_3$—50% thru 50 mesh	1.25
Greencastle, Ind. — Analysis, 98% $CaCO_3$—50% thru 50 mesh	2.00
Kansas City, Mo.—50% thru 100 mesh	1.50
Krause and Columbia, Ill.—Analysis, 90% $CaCO_3$, 90% thru 4 mesh	1.40
Lannon, Wis.—Analysis, 54% $CaCO_3$, 44% $MgCO_3$—90% thru 50 mesh	2.00
Marblehead, Ohio — Analysis, 83.54% $CaCO_3$, 14.92% $MgCO_3$; pulv. limestone; 70% thru 100 mesh; 60% thru 50 mesh; 100% thru 10 mesh; sacks	4.50
Bulk	3.00
Milltown, Ind. — Analysis, 94.41% $CaCO_3$, 2.95% $MgCO_3$—40.8% thru 100 mesh, 61.2% thru 50 mesh	1.40@1.50
Mitchell, Ind. — Analysis, 97.65% $CaCO_3$, 1.76% $MgCO_3$—50% thru 100 mesh	1.50
Montrose, Ia.—90% thru 100 mesh	1.25
Narlo, Ohio—Analysis 56% $CaCO_3$, 43% $MgCO_3$, limestone screenings, 37% thru 100 mesh; 55% thru 50 mesh; 100% thru 4 mesh	1.50@2.00
Ohio (different points), 20% thru 100 mesh; bulk	1.25@1.50
Piqua, O.—90% thru 100	3.25@5.00
40% thru 100	1.75@2.00
100% thru 4	1.25
River Rouge, Mich. — Analysis, 54% $CaCO_3$, 40% $MgCO_3$; bulk	.80@1.40
Stolle, Ill., near East St. Louis on I. C. R. R.—Thru ½-in. mesh	1.30
Stone City, Ia.—Analysis, 98% $CaCO_3$ 50% thru 100 mesh	.75

(Continued on next page)

Agricultural Limestone

(Continued from preceding page.)

Toledo, Ohio—¼-in. to dust, 20% thru 100 mesh ..... 1..0
Waukesha, Wis.—No. 1 kiln dried..... 2.00
No. 2 Natural..... 1.75
Chasco, Ill.—Analysis, 96.12% $CaCO_3$, 2.5% $MgCO_3$—90% thru 100 mesh..... 5.00
90% thru 50 mesh..... 1.35
Yellow Springs, Ohio—Aanlysis 96.08% $CaCO_3$, 63% $MgCO_3$, 32% thru 100 mesh; 95.57%, sacked, 6.00; bulk.... 4.25

SOUTHERN:

Alderson, W. Virginia—Analysis 90% $CaCO_3$; 90% thru 50 mesh..... 1.75
Cape Girardeau, Mo. — Analysis, 93% $CaCO_3$, 3.5% $MgCO_3$ — 50% thru 100 mesh 2.00
90% thru 4 mesh..... 1.50
Cartersville, Ga.—Analysis, 54% $CaCO_3$, 41% $MgCO_3$—all passing 10 mesh..... 2.00
Claremont, Va.—Analysis, 92% $CaCO_3$, 2% $MgCO_3$—90% thru 100 mesh, 4.00; 50% thru 100 mesh, 3.00; 90% thru 50 mesh, 3.00; 50% thru 50 mesh, 2.75; 90% thru 4 mesh, 2.75; 50% thru 4 mesh..... 2.75
Ft. Springs, W. Va.—Analysis, 90% $CaCO_3$—90% thru 50 mesh..... 1.75
Hot Springs, N. C.—50% thru 100 mesh, sacks, 4.25; bulk..... 3.00
Knoxville, Tenn.—80% thru 100 mesh; bulk, 2.70; 100% thru 10 mesh..... 2.30
Ladds, Ga.—50% thru 50 mesh..... 2.00
Linnville Falls, N. C.—Analysis, 53% $CaCO_3$; 42% $MgCO_3$—50% thru 100 mesh; 2.50 per ton bulk, 3.50 per ton mesh 200-lb. burlap; crushed limestone, ¾ down, including dust, 1.00; 1 to ⅜, 1.60; 2-in. and less..... 1.40
Mountville, Va. — Analysis, 76.60% $CaCO_3$, 22.83% $MgCO_3$—X thru 20 mesh; sacks 5.00

WESTERN:

Colton, Calif.—Analysis, 95% $CaCO_3$, 2-4% $MgCO_3$—all thru 14 mesh—bulk 4.00
Garnett, Okla.—Analysis, 80% $CaCO_3$, 3% $MgCo_3$; 50% thru 50 mesh ..... .50
Kansas City, Mo., Corrigan Sid'g—50% thru 100 mesh; bulk..... 1.80
Tulsa, Okla.—90% thru 4 mesh..... .50

Miscellaneous Sands

Silica sand is quoted washed, dried and screened unless otherwise stated.

GLASS SAND:

Baltimore, Md. 2.25
Berkley Springs, W. Va.....2.00@ 2.25
Cedarville and South Vineland, N. J.—Damp, 1.75; dry..... 2.25
Cheshire, Mass. .....5.00@10.00
Columbus, Ohio—Glass sand.....1.50@ 2.50
Dunbar, Pa.—Damp 2.00
Falls Creek, Pa. 2.50
Hancock, Md.—Damp.....1.25@ 1.75
Klondike and Pacific, Mo.....2.00@ 2.50
Mapleton, Pa. .....2.00@ 2.25
Massillon, Ohio 3.00
Michigan City, Ind.—Glass sand.....50@ .55
Mineral Ridge, Ohio.....2.50@ 2.75
Green 2.00
Montoursville, Pa. 1.75
Oregon, Ill.—Glass sand.....1.25@ 1.75
Ottawa, Ill. 2.50
Pittsburgh, Pa.—Dry, 4.00; damp..... 3.00
Rockwood, Mich. 2.50
Round Top, Md.—Dry..... 1.25
San Francisco, Cal.....3.00@ 3.50
St. Mary's, Pa. 2.25
Thayers, Pa. 2.00
Utica, Ill. .....1.25@ 1.50
Zanesville, Ohio .....2.00@ 2.50

FOUNDRY SAND:

Albany, N. Y.—Sand blast..... 4.00
Molding fine and brass molding..... 2.00
Molding coarse 1.75
Allentown, Pa.—Core and molding fine 1.50@1.75
Arenzville, Ill.—Molding fine..... 1.40@1.60
Beach City, O. — Core, washed and screened ..... 2.00@2.50
Furnace lining ..... 2.50@3.00
Molding fine and coarse..... 2.25@2.50
Cheshire, Mass.—Furnace lining, molding, fine and coarse..... 5.00
Sand blast ..... 5.00@8.00
Stone sawing 6.00
Cleveland, O.—Molding coarse..... 1.50@2.00
Brass molding ..... 1.50@2.00
Molding fine ..... 1.50@2.25
Core ..... 1.25@1.50
Columbus, Ohio—Core ..... .30@2.00
Sand blast ..... 3.50@5.00
Furnace Lining 1.75
Molding fine 2.00
Molding coarse ..... 1.50@2.00
Stone sawing ..... 1.50@2.00
Traction ..... .90
Brass molding ..... 2.00@2.50

(Continued on next page)

Wholesale Prices of Sand and Gravel

Prices given are per ton, F. O. B., at producing plant or nearest shipping point

Washed Sand and Gravel

City or shipping point	Fine Sand, 1/10 inch down	Sand, ¼ inch and less	Gravel, ½ inch and less	Gravel, 1 inch and less	Gravel, 1½ inch and less	Gravel, 2 inch and less
EASTERN:						
Attica, N. Y.	.75	.75	.75	.60	.60	.60
Ambridge and So. Heights, Pa.	1.15	1.15	1.15	1.15	.70	.70
Buffalo, N. Y.	1.10	.95			.85	
Erie, Pa.		.65	.90		1.00	
Farmingdale, N. J.	.48	.48	1.00	1.20	1.20	
Hartford, Conn.	.90		1.25	1.15	1.15	1.1[illegible]
Leeds Junction, Me.		.50	1.75	1.35		1.25
Machias, N. Y.	.95	.95	1.25	.85	.85	.85
Pittsburgh, Pa.	1.15	1.15	1.15	.70	.70	.70
Portland, Maine		.50	1.75		1.35	1.35
Washington, D. C. (rewashed, river)	.75	.75	1.60	1.40	1.20	1.20
CENTRAL:						
Alton, Ill.		.85				
Anson, Wis.	.40	.40				.90
Barton, Wis.		.60		.70	.70	
Beloit, Wis.		.50			.50	
Chicago, Ill.		1.75@2.23	1.75@2.43			
Cincinnati, Ohio	.70	.65	.90	.90	.90	.90
Columbus, Ohio	.75	.75@1.00	.65@1.00	.75@1.00	.75@1.00	.75
Des Moines, Iowa	.60	.60	1.70	1.70	1.70	1.70
Detroit, Mich.	.65	.65	.95	.95	.95	.95
Earlestead (Flint), Mich.	.70		60-40 sieves, .85; Pebbles, .95			
Eau Claire, Wis.	.40	40	1.00@1.25	1.00		.90
Elkhart Lake, Wis.	.50	.40	.60	.50	.50	.50
Ft. Dodge, Ia.		1.22		2.17		
Grand Rapids, Mich.		.50		.80		.70
Greenville, Mechanicsburg, O.	.65	.65	.65	.65	.65	.65
Hamilton, Ohio		.90			.90	
Hawarden, Ia.		.50			1.60	
Hersey, Mich.		.40		.60	.60	
Indianapolis, Ind.	.60	.60		1.50	.75@1.00	.75@1.00
Janesville, Wis.		.65@ .75			.65@ .75	
Libertyville, Ill.		.50		.70		
Mankato, Minn.—Pit run	.50	.40	.40		1.25	
Mason City, Ia.	.65	.55	1.70	1.60	1.55	1.55
Mendota, Ill.	.80	.80@ .95		.80@ .95	.70@ .85	
Milwaukee, Wis.	1.06	1.06	1.26	1.26	1.26	
Minneapolis, Minn.	.35	.35	1.25@1.35	1.25@1.35	1.25	1.25
Moline, Ill.	.60	.60	1.20@1.40	1.20@1.40	1.20@1.40	1.20@1.40
Riton, Wis.		.60			.80	
St. Louis, Mo., f.o.b. cars	1.30	1.10	1.50	1.30		1.25
St. Louis, Mo., delivered on job	2.05	2.20	2.35	2.15		2.10
Summit Grove, Clinton, Ind.	.65@ .75	.60@ .75	.60@ .75	.60@ .75	.60@ .75	.60@ .75
Terre Haute, Ind.	1.00	1.00	1.00	1.25	1.00	1.00
Waukesha, Wis.	.50		All other sizes, .70 per ton			
Winona, Minn.	.40	.40	1.25	1.00	1.00	1.00
Yorkville, Sheridan, Moronts, Oregon, Ill.	.60	.50@ .70		.60@ .80	.50@ .70	.60
SOUTHERN:						
Alexandria, La.		.70			1.20@1.35	
Birmingham, Ala.	1.48		all gravel—1.88			
Charleston, W. Va.		1.40	1.50			
Estill Springs, Tenn.	1.35	1.15		1.00	.85	.65
Ft. Worth, Tex.		2.00		2.00		2.00
Jackson's Lake, Ala.	.50@ .60	.50@ .60	.40@1.00	1.00	.50@1.00	.50@1.00
Knoxville, Tenn.	.75	1.00	1.50	1.50	1.50	1.50
Lake Weir, Fla.		.60				
Macon, Ga.		.50@ .75				
Memphis, Tenn.	1.12	1.12				1.95
N. Martinsville, W. Va.	1.00	1.00				.80
New Orleans, La.		.50			1.00	
Pine Bluff, Ark.	1.20	.90	Washed gravel, all sizes, 2.25			
Roseland, La.	.50			1.00		
WESTERN:						
Grand Rapids, Wyo.	.50	.50	.85	.85	.80	.80
Kansas City, Mo.	(Kaw River sand, car lots, .75 per ton. Missouri River, .85)					
Los Angeles, Calif.		1.00		1.50	1.50	
Pueblo, Colo.	1.10*	.90*			1.50	
San Diego, Calif.	.80@1.00	.80@1.00	1.30@1.60	1.25@1.55	1.15@1.45	1.15@1.45
San Francisco, Calif.		1.00	1.00@1.20	.85@1.00	.85@1.00	85@1
Seattle, Wash.	1.00*	1.00*	1.00*	.85*	.85*	1.00*

Bank Run Sand and Gravel

City or shipping point	Fine Sand, 1/10 inch	Sand, ¼ inch	Gravel, ½ inch	Gravel, 1 inch	Gravel, 1½ inch	Gravel, 2 inch
Boonville, N. Y.	.60@ .80		.55@ .75			1.00
Cape Girardeau, Mo.			River sand, 1.00 per yd.			
Cherokee, Iowa			.80 per ton—1.20 washed			
Dudley, Ky. (Crushed Sand)	1.00	1.00		.90		
East Hartford, Conn.			.65 per cu. yd.			
Estill Springs, Tenn.						.85
Fishers, N. Y.		.50@ .65		.50@ .65		
Grand Rapids, Mich.						.50
Hamilton, Ohio			.45 per cu. yd. in pit			
Hartford, Conn.		1.00*				
Hersey, Mich.				.50	.50	
Indianapolis, Ind.			Mixed gravel for concrete work, .65			
Lindsay, Tex						.55
Janesville, Wis.		.65			.65@ .75	
Pine Bluff, Ark.			Road gravel .50			
Rochester, N. Y.	.60@ .75	.60@ .75			.50@ .65	.50@ .65
Roseland, La.		.75				
Saginaw, Mich., f.o.b. cars		.75	1.30	1.30	1.30	1.30
St. Louis, Mo.			60% gravel, 40% sand, 1.40			
Summit Grove, Ind.	.50	.50	.50	.50	.50	.50
Waco, Tex.		.80		1.50		1.30
Winona, Minn.			Clean pit run .60			
York, Pa.		.95@1.10	(crushed rock sand)			

*Cubic yard. B Bank. L Lake. || Ballast.

Crushed Slag

City or shipping point	Roofing	¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:							
Buffalo, N. Y.	2.35	1.35	1.35	1.35	1.35	1.35	1.35
E. Canaan, Conn.	4.00	1.00	2.50	1.35	1.25	1.25	1.25
Eastern Pennsylvania and Northern New Jersey	2.00	1.20	1.50	1.20	1.20	1.20	1.20
Easton, Pa.	2.00	.70	1.25	.90	.85	.80	.80
Erie, Pa.	2.35	1.35	1.35	1.35	1.35	1.35	1.35
Emporium, Pa.			1.35	1.35		1.35	1.35
Sharpsville and West Middlesex, Pa.	2.00	1.30	1.70	1.30	1.30	1.30	1.30
Western Pennsylvania	2.00	1.25	1.50	1.25	1.25	1.25	1.25
CENTRAL:							
Chicago, Ill.			All sizes, 1.50, F. O. B. Chicago				
Detroit, Mich.			All sizes, 1.65, F. O. B. Detroit				
Ironton, O.	2.05	1.45	1.75	1.45	1.45	1.45	1.45
Steubenville, O.	2.00	1.40	1.70	1.40	1.40	1.40	1.40
Toledo, O.	1.92	1.67	1.77	1.77	1.77	1.67	1.67
			(Any delivery in city except team track deliveries)				
Youngstown, Dover, Hubbard, Leetonia, Struthers, O.	2.00	1.25	1.50	1.25	1.25	1.25	1.25
Steubenville, Lowellville and Canton, O.	2.00	1.35	1.60	1.35	1.35	1.35	1.35
SOUTHERN:							
Ashland, Ky.		1.55		1.55	1.55	1.55	1.55
Birmingham, Ala.	2.05	.80	1.25	1.15	1.10	.95	.85
Ensley, Ala.	2.05	.80	1.25	1.15	1.10	.95	.85
Longdale, Goshen, Glen Wilton & Low Moor, Roanoke, Va.	2.50	1.00	1.00	1.25	1.25	1.15	1.05

Lime Products (Carload Prices Per Ton F.O.B. Shipping Point)

	Finishing Hydrate	Masons' Hydrate	Agricultural Hydrate	Chemical Hydrate	Ground Burnt Lime Blk.	Ground Burnt Lime Bags	Lump Lime Blk.	Lump Lime Bbl.
EASTERN								
Adams, Mass.			7.00				2.80	
Bellefonte, Pa.			8.00	9.00	8.00		7.00	
Berkley, R. I.			12.00					2.30
Buffalo, N. Y.	10.50	9.00	8.50@11.00	11.00	7.25	9.25	8.00	1.50
Chaumont, N. Y.					2.50	4.00		
Lime Ridge, Pa.							5.00	
West Rutland, Vt.	13.50@14.00	11.00@11.50	11.00@11.50	13.50	10.00		11.00	3.50
West Stockbridge, Mass.								2.25
Williamsport, Pa.			10.00			10.00	6.00	
York, Pa. (dealers' prices)		10.50	10.50	11.50			8.50	1.65*
Zylonite, Mass.	3.20d	2.90d	7.00					
CENTRAL:								
Cold Springs, Ohio	10.50	9.00	8.50		7.25	9.25	8.00	
Delaware, Ohio	10.50	9.50	8.50	10.00			8.50	1.60
Gibsonburg, Ohio	10.50	9.00	8.50		7.25	9.25	8.00	
Huntington, Ind.	10.50	9.00	8.50				8.00	1.70*
Luckey, Ohio	10.50	9.00	8.00					
Marblehead, Ohio	10.50	9.00	8.50				8.00	1.50*
Mitchell, Ind.		11.00	11.00	11.00	9.50		8.50	1.45
Sheboygan, Wis.								7.50d
White Rock, Ohio	10.50	9.00	8.50	11.00	7.25	9.25	8.00	1.50
Woodville, O. (dlrs.' price)	10.50a	10.50a	8.00a	10.50a	7.25		8.00	1.60
SOUTHERN:								
Erin, Tenn.							6.00	1.00
Karo, Va.							7.00	1.30
Knoxville, Tenn.	22.00	9.50@11.00	9.50	10.50			7.50	1.30
Ocala and Zuber, Fla.	13.00	13.00	13.00	13.00		12.00	12.00	1.60
Sherwood, Tenn.	12.00	11.00					8.50	1.50
Staunton, Va.					7.00	8.00	7.50b	1.40
WESTERN:								
Colton, Calif.			15.00				19.70	
Kirtland, N. Mex.							15.00	
San Francisco, Calif.	22.00	22.00	15.00	22.00				2.15*
Tehachapi, Calif.							13.00	2.00

‡100-lb. sacks; *180-lb. net, price per barrel; †180-lb. net, non-returnable metal barrel; §Paper sacks. (a) 50-lb. paper bags; terms, 30 days net; 25c per ton or 5c per bbl. discount for cash in 10 days from date of invoice. (b) Burlap bags. (c) 200-lb. bbl. (d) 280-lb. bbl. net.

Miscellaneous Sands

(Continued from preceding page)

Delaware, N. J.—Molding fine	2.00
Molding coarse	1.90
Brass molding	2.15
Dresden, O.—Core and traction	1.00
Molding, fine and coarse	1.25
Brass molding	1.50
Dunbar, Pa.—Traction, damp	2.25
Dundee, O.—Glass, core, sand blast, traction	2.50
Molding fine, brass molding (plus 75c for winter loading)	2.00
Molding coarse (plus 75c for winter loading)	1.75
Eau Claire, Wis.—Core	1.00
Sand blast	3.25@3.75
Traction	.30@ .50
Falls Creek, Pa.—Molding, fine and coarse	1.75
Sand blast	2.00
Traction	1.75
Franklin, Pa.—Core	1.25@1.75
Furnace lining	2.50
Molding fine	2.00
Molding coarse	1.75
Brass molding	2.00
Greenville, Ill.—Molding coarse	1.30@1.50
Joliet, Ill.—Milled, dried and screened No. 2 coarse molding sand and open hearth loam and luting clay only)	.60@ .80 .70
Kansas City, Mo.—Missouri River core	.80
Kasota, Minn. — Molding coarse and	
Klondike, Pacific, Gray Summit, Mo.—Glass sand, furnace lining, molding coarse	2.00@2.50
Molding fine	2.00
Mapleton, Pa.—Glass, core, furnace lining, molding fine and coarse, roofing sand, sand blast, stone sawing, traction, brass molding; damp, 2.25; dry	2.75
Massillon, O. — Traction, molding fine and coarse, furnace lining, core	2.75
Michigan City, Ind.—Core, traction	.40@ .45
Mineral Ridge, Ohio—(Green) core	2.00
Furnace lining, molding fine and coarse, roofing, sand blast, stone sawing and traction, brass molding	2.00
Montoursville, Pa.—Core	1.25@1.50
Traction	1.00@1.25
Molding fine	1.50
Molding coarse	1.50@2.00
New Lexington, O.—Molding fine	2.00
Molding coarse	1.50
Oregon, Ill.—Core, furnace lining	1.25@1.75
Sand blast	3.00@3.50
Stone sawing	3.00@3.50
Traction	1.25
Ottawa, Ill.—Core, furnace lining, molding fine and coarse, traction, brass molding	2.50
Roofing sand	2.50@3.00
Sand blast	3.50
Stone sawing	3.00
Ottawa, Minn.—All crude silica sand	.75@1.25
Pelzer, S. C.—Glass sand (carload lots	
Rockwood, Mich.—Core, damp	1.90
Roofing	2.75
Sand blast	3.75
fine, stone sawing (pit run)	1.75

Miscellaneous Sands

(Continued)

Round Top, Md.—Glass sand	1.75@2.00
Core, furnace lining	1.45
Traction	1.60
(All per 2000 lbs.)	
San Francisco, Cal. (Washed and dried)—Core, molding fine, roofing sand and brass molding	3.00@3.50
Direct from pit.	
Furnace lining, molding coarse, sand blast	3.60
Stone sawing, traction	2.30
Thayers, Pa.—Core	1.75
Furnace lining	2.00
Molding fine and coarse	1.25
Traction	1.75
Utica, Ill.—Core	1.00
Furnace lining	1.25@1.50
Molding fine	.90
Molding coarse	1.00
Stone sawing	1.25
Utica, Pa.—Core	1.25@2.25
Molding fine and coarse, traction, brass molding	2.00
Warwick, O. — Core, furnace lining, molding fine and coarse (damp, 1.75) dry	2.00
Traction, brass molding (dry)	2.00
Zanesville, Ohio — Brass molding and molding fine	1.50@1.75
Molding coarse	1.15@1.40

Talc

Prices given are per ton f. o. b. (in carload lots only) producing plant, or nearest shipping point.

Asheville, N. C.—Crude talc	5.00
Ground talc (20-50) mesh), bag extra	7.00
Ground talc (150-200 mesh), bag extra	8.00
Pencils and steel workers' crayons, per gross	1.30@ 2.00
Baltimore, Md.—Ground talc (20-50 mesh), bags	10.00
Ground talc (150-200 mesh), bags	14.00
Cubes	50.00
Blanks (per lb.)	.07
Chatsworth, Ga.—Crude talc	7.00
Ground talc (150-200 mesh); bags	10.00@12.00
Pencil and steel workers' crayons	1.25@3.00
Chester, Vt.—Crude talc	5.50
Ground talc (150-200 mesh) incl. bags	8.00@10.00
Emeryville, N. Y.—200-325 mesh; bags	14.00@16.00
Glendale, Calif.—Ground talc (150-200-mesh)	16.00@30.00
(Bags extra)	
Ground talc (50-300 mesh)	13.50@15.50
200 mesh	13.50@14.50
Hailesboro, N. Y.—Ground talc (150-250 mesh), bags	18.00
Henry, Va.—Crude talc (lump mine run), per 2000-lb. ton	2.75@ 3.50
Ground talc (20-50 mesh)	6.50@ 7.75
(150-200 mesh) bags	8.75@13.50
Johnson, Vt. — Ground talc (20-50 mesh), bulk 7.50; (150-200 mesh)	8.00@15.00
(Bags extra)	
Ground talc (150-200 mesh), bulk	10.00@15.00
(Bags extra)	
Los Angeles, Calif.—Ground talc (200 mesh) (includ. bags)	16.00@20.00
Mertztown, Pa.—Ground talc (20-50 mesh); bulk 4.00; bags	5.00
(150-200 mesh); bulk 6.00; bags	7.00
Natural Bridge, N. Y.—Ground talc (150-200 mesh) bags	12.00@13.00
Rochester and East Granville, Vt.—Ground talc (20-50 mesh), bulk	8.50@10.00
(Bags extra)	
Ground talc (150-200 mesh), bulk	10.00@22.00
(Bags extra)	
Vermont—Ground talc (20-50 mesh); bags	7.50@10.00
Ground talc (150-200 mesh); bags	8.50@15.00
Waterbury, Vt. — Ground talc (20-50 mesh), bulk	7.50
(Bags 1.00 extra)	
Ground talc (150-200 mesh), bulk	9.00@14.00
(Bags 1.50 extra)	
Pencils and steel workers' crayons, per gross	1.20@ 2.00

Rock Phosphate

Raw Rock

Per 2240-lb. Ton

Centerville, Tenn—B.P.L. 72% to 75%	6.00@8.50
B.P.L. 65%	6.00
Gordonsburg, Tenn.—B.P.L. 65%-70%	4.00@5.50
Tennessee—F. o. b. mines, long tons, unground Tenn. brown rock, 72% B. P. L.	7.00
Mt. Pleasant, Tenn. — Analysis, .70 B.P.L. (2000 lbs.)	6.50
Montpelier, Idaho—70% B.P.L.—Crude	4.75
Crushed 2-in. ring and dried	5.00
Paris, Idaho.—2,000 lb. mine run, B.P.L. 70%	4.00

(Continued on next page)

Roofing Slate

The following prices are per square (100 sq. ft.) for Pennsylvania Blue-Gray Roofing Slate, f.o.b. cars quarries:

Sizes	Genuine Bangor, Washington Big Bed, Franklin Big Bed	Genuine Albion	Slatington Small Bed	Genuine Bangor Ribbon
24x12	$ 9.30	$8.40	$8.10	$7.80
24x14	9.30	8.40	8.10	7.80
22x12	10.80	8.70	8.40	9.10
22x11	10.80	8.70	8.40	9.10
20x12	10.80	8.70	8.40	9.10
20x10	11.70	9.00	8.70	8.40
18x10	11.70	9.00	8.70	8.40
18x 9	11.70	9.00	8.70	8.40
16x10	11.70	8.40	8.40	8.10
16x 9	11.70	8.40	8.40	8.10
16x 8	11.70	8.40	8.40	8.10
18x12	11.10	8.70	8.40	8.10
16x12	11.10	8.70	8.40	8.10
14x10	11.10	8.40	8.10	7.80
14x 8	11.10	8.40	8.10	7.80
14x 7 to 12x6	9.60	8.40	8.10	.....
	Mediums	Mediums	Mediums	Mediums
24x12	$ 8.10	$7.50	$7.20	$5.75
22x11	8.40	7.80	7.50	5.75
Other sizes	8.70	8.10	7.80	5.75

For less than carload lots of 20 squares or under, 10% additional charge will be made.
Granulated slate per net ton f. o. b. quarries, Vermont and New York, 7.50.

(Continued from preceding page)

Ground Rock

Wales, Tenn.—B.P.L. 70%	7.75
Per 2000-lb Ton	
Barton, Fla. — Analysis, 50% to 65% B.P.L.	3.50@6.00
Centerville, Tenn.—B.P.L. 65%	6.00
B.P.L. 75% (brown rock)	12.00
Columbia, Tenn.—B.P.L. 68% to 72% B.P.L. 65% (90% thru 200 mesh) bulk	5.50
	5.50
Morriston, Fla.—Analysis, 35% B.P.L.	12.00
Mt. Pleasant, Tenn.—B.P.L. 70%	5.00@6.50

Florida Soft Phosphate

Raw Land Pebble

Per Ton	
Bartow and Norwills, Fla.—B.P.L. 50%, bulk	6.00@ 8.00
B.P.L. 78%, bulk	13.50
Florida—F. o. b. mines, long ton, 68/66% B.P.L.	3.00
68% (min.)	3.25
70% (min.)	3.50
Jacksonville (Fla.) District	10.00@12.00

Ground Land Pebble

Per Ton	
Jacksonville (Fla.) District	14.00
Add 2.50 for sacks.	
Lakeland, Fla.—B.P.L. 60%	6.00
Morristown, Fla.—26% phos. acid	16.00
Mt. Pleasant, Tenn.—65-70% B.P.L.	5.00@ 6.00

Special Aggregates

Prices are per ton f. o. b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco chips
Chicago, Ill.—Stucco chips, in sacks f.o.b quarries		17.50
Deerfield, Md. — Green; bulk	7.00	7.00
Easton, Pa.—Evergreen, creme green and royal green marble	8.00@10.00	12.00@14.00
Slate granules		7.00@8.00
Granville, N. Y. — Red slate granules		7.50
Ingomar, Ohio	12.00@25.00	12.00@25.00
Lincoln, Neb. — Red, white, gray, in bags		30.00
granite; sacks	28.50@30.00	20.00@22.50
Milwaukee, Wis.		20.00@30.00
New York, N. Y.—Red and yellow Verona		32.00
Middlebrook, Mo.—Red		25.00@30.00
Phillipsb'g, N. J.—Green stucco dash		12.00@14.00
Piqua, O.—Marble		7.00@ 9.00
Poultney, Vt. — Roofing granules		7.50
Red Granite, Wis.		7.50
Sioux Falls, S. D.	7.50	7.50
Tuckahoe, N. Y.	12.00	14.00
Whitestone, Ga.—White marble chips, net ton in bulk, f.o.b., bags		
10c extra	5.00	5.00

Concrete Brick

Prices given per 1,000 brick, f. o. b. plant or nearest shipping point.

	Common	Face
Appleton, Minn.	20.00	25.00@35.00
Bellows Falls, Vt.	18.00	25.00@35.00
Birmingham, Ala.	13.50	25.00@35.00
Carpenterville, N. J.	20.00	36.00
Easton, Pa.	16.00	40.00@60.00
Eugene, Ore.	25.00@26.00	50.00@75.00
Friesland, Wis.	20.00	33.00
Houston, Tex.		19.50
Lockport, N. Y.	16.00	
Omaha, Neb.	20.00	30.00
Piqua, O.	15.00	25.00
Portland, Ore. (Del'd)	21.00	30.00@60.00
Puyallup, Wash.	18.00	25.00@75.00
Rapid City, S. D.	18.00	25.00@40.00
Rochester, N. Y.	21.00	
St. Paul, Minn.	15.00	30.00@35.00
Salem, Ore.	25.00	35.00@50.00
Salt Lake City, Utah	17.00@18.00	35.00@40.00
Seattle, Wash.	22.00	35.00@80.00
Springheld, Ill.	18.00	24.00@25.00
Tampa, Fla.	15.00	25.00@65.00
Wauwatosa, Wis.	14.00@15.00	30.00@65.00

Sand-Lime Brick

Prices given per 1,000 brick f. o. b. plant or nearest shipping point, unless otherwise noted.

Albany, Ga.	7.00
Barton, Wis.	10.00
Boston, Mass.	14.00@15.00
Brighton, N. Y.	14.75
Buffalo, N. Y.	16.50
Dayton, Ohio	12.50@13.50
El Paso, Texas	13.00
Grand Rapids, Mich.	12.50
Lancaster, N. Y.	13.50
Michigan City, Ind.	11.00
Milwaukee, Wis.	13.50
Minneapolis, Minn.	13.00
Plant City, Fla.	10.00
Portage, Wis.	15.00
Redfield, Mass.	15.00
Rives Junction, Mich.	11.00
Saginaw, Mich.	11.00
San Antonio, Texas—Common	15.00
South Dayton, Ohio	12.50@13.50
Syracuse, N. Y. (delivered at job)	18.00
f.o.b. cars	14.00
Washington, D. C.	14.50
Winnipeg, Can.	17.00@25.00

Lime

Warehouse prices, carload lots at principal cities.

	Hydrate per Ton Finishing	Common
Atlanta, Ga.	19.00	16.00
Baltimore, Md.	15.00	13.00
Boston, Mass.	23.00	20.00
Cincinnati, Ohio	19.60	14.50
Chicago, Ill.	18.00	.....
Dallas, Tex.	25.00	.....
Denver, Colo.	30.00	.....
Detroit, Mich.	15.25	13.25
Fort Dodge, Ia.	19.70	17.00
Grand Rapids, Mich.	15.65	.....
Los Angeles, Calif.	30.00	30.00
Minneapolis, Minn.	29.00	22.00
Montreal, Que.	21.00	21.00
New Orleans, La.	.....	17.25
New York, N. Y.	16.99	.....
St. Louis, Mo.	23.20	20.00
San Francisco, Calif.	22.00	18.00
Seattle, Wash.	27.00	.....

	Lump per 180-lb. Barrel (net) Finishing	Common
Atlanta, Ga.	2.00	1.50
Baltimore, Md.	.....	12.00†
Boston, Mass.	3.35	3.10
Cincinnati, Ohio	.....	12.25
Chicago, Ill.	.....	1.40
Denver, Colo.	.....	2.95
Detroit, Mich.	11.50†	10.50†
Los Angeles, Calif.	3.00*	3.00*
Minneapolis, Minn.	1.70	1.40
New Orleans, La.	.....	1.75
New York, N. Y.	.....	3.69*
St. Louis, Mo.	.....	.70*
San Francisco, Calif.	.....	1.90
Seattle, Wash.	3.25	2.75
Sheboygan, Wis.	.....	10.00

*280-bbl. (net). †Per ton.

Portland Cement

Current prices per barrel in carload lots, f. o. b. cars, without bags.

Atlanta, Ga. (bags)	3.45
Boston, Mass.	2.61
Cedar Rapids, Iowa	2.48
Cincinnati, Ohio	2.59
Cleveland, Ohio	2.46
Chicago, Ill.	2.20
Dallas, Tex.	2.25
Davenport, Iowa	2.43
Denver, Colo.	2.65
Detroit, Mich.	2.48
Duluth, Minn.	2.14
Indianapolis, Ind.	2.41
Kansas City, Mo.	2.30
Los Angeles, Calif.	3.06
Milwaukee, Wis.	2.37
Minneapolis, Minn.	2.39
Montreal, Can. (sacks 20c extra)	2.40
New Orleans, La.	2.80
New York, N. Y. (includes bags)	2.40
(10c per bbl. discount in 10 days)	
Peoria, Ill.	2.41
Pittsburgh, Pa.	2.24
Portland, Ore.	3.00
St. Louis, Mo.	2.35
San Francisco, Calif.	2.63
St. Paul, Minn.	2.39
Toledo, Ohio	2.53
Seattle, Wash.	2.90

NOTE—Add 40c per bbl. for bags.

Gypsum Products— CARLOAD PRICES PER TON AND PER M SQUARE FEET, F. O. B. MILL

	Crushed Rock	Ground Gypsum	Agricultural Gypsum	Stucco* Calcined Gypsum	Cement‡ and Gauging Plaster	Wood Fiber	White§ Gauging	Sanded Plaster	Keene's Cement	Trowel Finish	Plaster Board ¼x32x36" Weight 1500 lb. Per M Sq. Ft.	Plaster Board ⅜x32x36" Weight 1850 lb. Per M Sq. Ft.	Wallboard, ⅜x32 or 48" Lengths 6'-10', 1850 lb. Per M Sq. Ft.
Douglas, Ariz.	.....	.....	6.00	13.00	.....	12.00	.....	.....	.....	14.00	.....	.....	.....
Fort Dodge, Iowa	3.00	3.50	6.00	8.00	10.00	10.50	20.00	.....	21.30	20.00	20.00	.....	30.00
Garbutt, N. Y.	.....	.....	6.00	8.00	10.00	10.00	.....	7.00	.....	.....	.....	20.00	.....
Grand Rapids, Mich.	3.00	.....	6.00	8.00	10.00	10.00	.....	.....	31.25	21.00	19.38	20.00	30.00
Hanover, Mont.	4.50	.....	6.00	10.00	.....	10.50	.....	.....	.....	.....	.....	.....	.....
Mound House, Nev.	.....	8.50	6.50	10.50@11.50	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oakfield, N. Y.	3.00	4.00	6.00	8.00	10.00	10.00	20.20	7.00+	30.75	21.00	19.375	20.00	30.00
Rapid City, S. D.	4.00	.....	.....	10.00	12.00	12.50	.....	.....	33.75	.....	.....	.....	.....
Winnipeg, Man.	5.50	5.50	7.00	13.50	15.00	15.00	.....	.....	.....	.....	28.50	.....	35.00

NOTE—Returnable Jute Bags, 15c each, $3.00 per ton; Paper Bags, $1.00 per ton extra.
*Shipment in bulk 25c per ton less; ‡Bond plaster $1.50 per ton additional; +Sanded Wood Fiber $2.50 per ton additional; §White Moulding 50c per ton additional; ||Bulk; (a) Includes sacks.

News of All the Industry

Incorporations

The Silica Rock Co., Ltd., Ottawa, Canada, has been incorporated for $85,000,000 to engage in quarrying.

The International Gypsum Corp., Seattle, Wash., has been incorporated for $60,000 by D. McMaster and J. T. Dixon.

The Silverdale Gravel Co., Arkansas City, Kans., has been incorporated by C. M. Boggs, H. A. Schramm and C. O. Durrance.

The Crystal Sand and Gravel Co., Boston, Mass., has been incorporated by J. W. Pearson, 132 Church street, Newton, and Charles D. Folsom.

The Valley Rose Marble Co., Sweetwater, Tenn., has been incorporated for $50,000 by S. T. Jones, G. W. Bryson and J. T. McKinley.

The Ann Arbor Sand and Gravel Co., Ann Arbor, Mich., has completed the installation of a washing machine in conjunction with its gravel pit.

The Duval Marble and Tile Co. has been incorporated at Jacksonville, Fla., for $10,000 by L. C. Rivas, president; F. E. Trapp, vice-president; and C. R. Bisbee, secretary.

The San Bernardino Valley Lime and Rock Co., San Bernardino, Calif., recently incorporated for $200,000, will engage in mining and producing rock and limestone for building and other purposes. Incorporators are J. D. Baugh, J. W. Bates, M. P. Bates, Julia Baugh and F. A. Wilson.

Gypsum

The Imperial Gypsum Co., organized about two years ago, has shipped its first carload of gypsum from the mine at Maria to a plaster firm in Los Angeles. The company was organized to utilize some of the gypsum lying on the Imperial County desert. As the gypsum deposits are above ground, the product is scooped up with a large shovel and loaded directly into the cars.

Dealers

The United Stone Co., Lansing, Mich., has been incorporated for $50,000 to handle building material.

The Central Mill and Warehouse Co. has been incorporated in Lansing, Mich., and will wholesale building material.

The Albert Stone Co., Dallas, Texas, has been incorporated for $25,000 to deal in building material by G. A. Beck, L. L. Eldridge and E. A. Stewart.

S. W. Johnson Co., Watertown, N. Y., has been incorporated for $25,000 by H. J. Helk, S. W. and J. C. Johnson, and will deal in cement and brick.

The J. J. Slattery Tile Co., Inc., 217 Brinely Ave., Bradley Beach, N. Y., has been incorporated for $100,000 and will deal in slate, stone, tile, brick, etc.

The Genesee Sand and Gravel Corp., Buffalo, N. Y., has been incorporated for $100,000 to deal in sand and gravel, building materials, etc. Incorporator is Herman Jaffe.

The Consolidated Brick Co., Melrose, Mass., has been incorporated for $98,000, to deal in brick and stone. Incorporators are G. L. Baldwin and Kathryn M. Danforth, Worcester, and J. E. Fraser, Melrose.

The Illinois Sand and Gravel Co., 343 South Dearborn street, Chicago, has been incorporated for $190,000, and will deal in building materials, gravel, etc. Incoporators are F. W. Renwick, G. B. Hart and R. E. Hammond.

Quarries

The Zenith Concrete Gravel Co., Earlton, Minn., contemplates putting in a $50,000 rock crushing plant. Bert Kelly is manager.

The Vermont Marble Co., Proctor, Vt., announces a general 10 per cent increase in wages, effective October 1. The company employs more than 3000 men.

Concrete Products

The Rib Stone Cement Stone Silos, Ltd., Winnipeg, Man., have been incorporated for $50,000 to manufacture cement products, etc.

The Fonthill Concrete Products Co., Welland, Ont., is completing a plant for manufacturing concrete drain and building tile and concrete brick.

The Farmer Concrete Works have been incorporated at St. Petersburg, Fla., for $20,000 by H. A. Farmer, president; E. D. Farmer, vice-president, and H. W. Farmer, secretary.

The Pacific Concrete Products Co., San Francisco, Calif., has been incorporated for $100,000 by L. C. Winters, D. K. Grady, M. T. Neff, G. Harrington and T. W. Dahlquist.

The Standard Roofing and Supply Co., Memphis, Tenn., has been incorporated for $25,000 by O. H. McMillan, Scott Carpenter, L. S. McMillan, M. E. Carpenter and H. H. Barker.

The Fourlock Tile Corp. of Maryland, Baltimore, Md., has been incorporated for $100,000 and has headquarters in the American building. Incorporators are F. E. Holt, H. W. Somers and W. L. Broman.

The Ridgeville Concrete Works and Fonthill Concrete Products Co., owned by T. W. Bishop, Ridgeville, Ont., will start this fall manufacturing sewer pipe, drain tile, brick, blocks and other cement products.

Cement

The Alpha Cement Co., Catskill, N. Y., has increased the wages of its employes 5 cents per hour.

The Phoenix Portland Cement Co., Birmingham, Ala., has begun the erection of a $2,500,000 plant.

The Dodson Cement Products Co., Dallas, Texas, contemplate establishing a $50,000 plant in El Paso.

The New York and New England Cement Co., Hudson, N. Y., has announced a 10 per cent increase in wages to all its employes.

The Dexter Portland Cement Co., Nazareth, Pa., is increasing its output by the addition of two 7x100 ft. Traylor rotary kilns.

The Kansas City Portland Cement Co. has established a school near its plant at Cement City, Mo., for the benefit of the children of the employees of the company.

The Nebraska Cement Co., Superior, Neb., made a record during August by shipping 90,000 bbl. of cement. The plant closed down for a few days because of coal shortage, but operations have been resumed.

The International Cement Co., Detroit, Mich., has declared quarterly dividends of 1¾ per cent on the preferred stock and 62½ cents on the common stock, both payable September 30, to stock of record September 15.

The Security Cement and Lime Co., Hagerstown, Md., is offering $300,000 in five-year 7 per cent gold notes to the public through the Baltimore Trust Co. This is being done to provide additional capital for improving and enlarging plant facilities. The plant has a capacity of 950,000 bbl. per year and is building additions to increase this figure to 1,400,000 bbl.

Sand and Gravel

Defiance, Ohio—Bert Blackburn has begun development of a sand pit on a stratum covering 40 acres east of Defiance.

The Gallup Sand and Gravel Co., Inc., 45 Mann building, Utica, N. Y., has changed its name to Boonville Sand Corp.

The Lankershim Sand and Gravel Co., recently organized at Lankershim, Calif., is erecting a plant on its 11-acre tract.

Oscola, Mo.—The Sac River Sand and Gravel Co., which suspended operations the first part of August, has resumed. The company was forced to suspend because of the car shortage.

The Rochelle Washed Gravel Co., Rochelle, Ill., has been formed by C. W. Clark and F. E. Gardner, and will erect a plant four miles south of Rochelle to pump gravel from the creek bed.

Victoria, Tex.—The Guadalupe River Navigation Co.'s sand and gravel interests will remove its plant to a point about a mile from its present location. This is necessary because of the exhaustion of the gravel supply. An entirely new and up-to-date plant will be built with a capacity of about 20 cars per day.

Lime

Woodville, Ohio—The Washington lime plant is building eight new kilns.

The American Lime and Stone Co., Bellefonte, Pa., increased the wages of all its employes 10 per cent.

The Bone-Dry Lime Corp., Cassadaga, N. Y., will establish a sales office at Fredonia in the Citizen's Trust Co. building.

Clarksville, Tex.—The Clarksville Chamber of Commerce is investigating the feasibility of erecting a lime kiln here. An abundance of lime rock and phosphate is said to be available in this vicinity.

The Mission Lime Marl Co., Niles, Calif., recently organized under the joint ownership of F. W. Keeney and R. H. Marchant, has installed temporary machinery to meet orders, and within three months the final equipment of the factory will be installed. A large deposit of lime marl, at least 300,000 tons, is owned by the company. When the new machinery is installed the plant will be able to turn out 150 to 200 tons of fertilizer a day.

Phosphate Rock

The Kreiss Process Products Co., 205 Graham building, Jacksonville, Fla., recently incorporated for $75,000, will begin the erection of a plant with a daily output of about 200 tons potassium phosphate, and will install rotary driers, mills and screens.

The Seminole Phosphate Co., Goldsboro, N. C., at its annual meeting elected the following officers: President, A. P. Petway; first vice-president, W. F. Walker; second vice-president, Henry A. Grady; secretary and sales manager, John W. Daniels.

Personal

Robert M. Miller, general manager of the Columbus Consumers Supply Co. and the Island Sand and Gravel Co., has been elected a director and secretary of both the above companies, succeeding David W. Jones.

John V. N. Dorr, of the engineering firm the Dorr Co., New York City, has recently returned to New York from a six months' trip to England, France and Germany, for the purpose of a closer acquaintance with the installations of Dorr methods in the metallurgical and chemical plants of those countries. Mr. Dorr found considerable industrial depression in England. In Germany he was impressed with the spirit of hard work which is evident on every hand. In spite of its present financial condition he feels that Germany has settled down to solving the great problems of its industrial rehabilitation.

Manufacturers

The Solvay Collieries Co., Huntington, W. Va., announces that its corporate name has been changed, effective October 1, to Kingston-Pocahontas Coal Co.

The Brown Hoisting Machinery Co., Cleveland, Ohio, announces that its conveyor sales are now in charge of E. P. Sawhill, who has had nearly 30 years' engineering and selling experience on this type of equipment.

Obituary

Herbert C. Follinger, manager of the Chicago office of the Chain Belt Co., died of pneumonia at his home in Chicago on September 27. He had been ill but a few days and the announcement of his death will come as a shock to his many friends in the industrial world. Mr. Follinger was 38 years old. He was born at Fort Wayne, Ind. In 1902 he was graduated from the Chicago Manual Training School, now part of the University of Chicago, and entered the employ of the Otis Elevator Co. He became associated with the Chain Belt Co. in 1914 and in 1916 was appointed district manager for the Chicago territory.

Trade Literature

"Armorframe"—The Pennsylvania Crusher Co., Philadelphia, Pa., in a recent circular, announces an improvement in single roll crusher design in its "Pennsylvania Armorframe." This machine will be on exhibit at the National Exposition of Mines and Mine Equipment, Cleveland, Ohio, October 9 to 14.

Utility Cars—The Differential Car Co., Inc., Findlay, Ohio, has recently issued Bulletin D-4, describing and illustrating its traversing tilting body cars. The purpose of this car is to afford the railways an efficient method of handling loose materials and in increasing transportation profits.

Coal Drier—The Vulcan Iron Works, Wilkes-Barre, Pa., announces Drier Circular No. 1, describing the Vulcan drier for coal, lignite, peat, ore, clay, marl, shale, chalk, gypsum, bone, bagasse, concentrates, etc. The circular has two interesting charts showing the capacities of the drier and also a diagram explaining its work.

Pulverizers—No. 368, the new catalog of the Jeffrey Mfg. Co., Columbus, Ohio, has 48 pages of description, data, and other information, together with numerous shop illustrations and installation views showing the application of Jeffrey swing hammer pulverizers built in three types—for general purposes; for breakdown machines and fine grinding; for fine grinding of limestone and similar rock.

"Lower Your Excavating Costs" is an illustrated folder on the Smith excavator and loader made by the T. L. Smith Co., Milwaukee. It features the fact that contractors who are using these machines for dragline excavating, digging sand and gravel, stripping, and miscellaneous earth handling are saving considerable time and money. Its new truck-type, four-cylinder motor of 4-in. bore and 5-in. stroke is also shown.

Rock Crushing Equipment—Catalog 29, of the Austin Mfg. Co., Chicago, is an exceptionally well-made book, both from its typography and its generally attractive appearance, covering 48 pages. These designers and builders of complete rock-crushing plants here describe this type of machinery, including crushers, bins, elevators, hoists, quarry cars, screens, travelers, etc. Parts specifications and plans are also given suitable space.

Line Shafting Equipment—No. 43 of the Medart Co., St. Louis, Mo., is a new condensed catalog of 192 pages devoted to its line shafting equipment. The aim of this company in preparing the catalog has been to state dimensions, details of construction and list prices in a way to enable engineers, designers, mechanics and power users to plan installations of and purchase the equipment described. A more complete catalog is in course of preparation. The company was established in 1879; today it occupies over a million feet of floor space with its pattern shops, foundries, machine shops, shafting mills and general manufacturing facilities.

Apologies to the McGann Mfg. Company

ON the front cover of Rock Products for August 26 the name of the McGann Mfg. Co., York, Pa., manufacturers of York lime kilns, dryers, hydrators and gas producers, appeared as the "McGain" Mfg. Co. While this error is most unfortunate, we are confident that this company's many friends and clients readily recognized the error and were aware of the true identity of the advertiser using our front cover for that issue.

William J. Kuntz, now the vice-president and general manager of the McGann Mfg. Co., it will be remembered, was for 20 years the general manager of the Steacy-Schmidt Mfg. Co., and the lime industry has been his hobby. Undoubtedly, his present connection will give the industry a wide opportunity to seek his services in a consulting capacity in the design and construction of any product in which his interest centers.

Classified Advertising

Rates for advertising in the Used Equipment Department: $2.50 per column inch per insertion. Minimum charge, $2.50. Please send check with your order. These ads must be paid for in advance of insertion.

BIDS WANTED

on quarrying 400,000 cubic yards of limestone. Quarry is open and will take the rock as fast as turned out. Performance bond will be required. For further information address

411 Cotton Exchange Building
Houston, Texas

POSITION WANTED

First class executive with 25 years' practical experience in the lime and quarry business is open for a position as manager or general superintendent where results will count. Would prefer opening where an interest could be secured, either by purchase or strict attention to business. Address

Box 1591, Care of Rock Products
542 South Dearborn Street Chicago, Ill.

TO LEASE

Sand and gravel washing plant, 25 miles from Chicago. Good terms. Small investment. Address

Box 1590 Care of Rock Products
542 South Dearborn Street, Chicago, Ill.

FOR SALE

92 acres of the purest high calcium limestone in the United States. Located at St. Genevieve, Mo., and adjacent to the Missouri-Illinois R. R. A splendid opportunity for a lime manufacturer that wishes to locate in this locality. Lime from this vicinity has a national demand and a modern lime plant would pay for itself in two years. Address

Mr. J. E. Schuerman
The St. Louis Steel Erection Co.
Syndicate Trust Bldg.
St. Louis, Mo.

Wanted, Cement Mill Superintendent

Cement Plant located in Lehigh Valley wants competent Superintendent. In your reply state fully past experience, reference, and salary. Address

Box 1589, Care of Rock Products
542 South Dearborn Street, Chicago, Ill.

POSITION WANTED

Sand and gravel plant manager desires to make change. Technically educated, 15 years' experience, age 36, married. Thoroughly familiar with modern plant design and all phases of operation. Address

Box 1592, Care of Rock Products
542 South Dearborn Street Chicago, Ill.

George Borrowman, Ph.D.
CHEMIST

Analyses, consultations, researches in connection with rock products, cements, clays, lime, plasters, zeolites, sands, etc.

9 So. Clinton St. Chicago, Ill.

H. E. WIEDEMANN
(Est. 1905)
Consulting and Analytical Chemist
Specialist in Analysis of Rock Products
Chemical Bldg. St. Louis

WANTED

Situation as manager or superintendent of works. Thoroughly experienced in the manufacture of portland cement, fertilizers, and agricultural limestone. Have given special attention to organization. Technically trained. Address

Box 1588, care of Rock Products
542 South Dearborn Street Chicago, Ill.

Take advantage of the Opportunity offered in the Used Equipment Department to dispose of the equipment that you no longer need.

Used Equipment

Rates for advertising in the Used Equipment Department: $2.50 per column inch per insertion. Minimum charge, $2.50. Please send check with your order. These ads must be paid for in advance of insertion.

Mine Cars, Rails and Ties

We have mine cars in stock for all purposes. Also rails 12 lb. to 100 lb. section. Spikes, bolts, frogs and switches. All trade is solicited and prices cheerfully quoted.

M. K. FRANK
Frick Building Pittsburgh, Pa.

FOR SALE

1 yd. Crescent Sauerman scraper, complete. Cheap if sold at once.

COLONIAL SAND & GRAVEL CO.
Lockport, Ill.

QUARRY EQUIPMENT

4—20 yd. Steel Underframe Side Dump Cars.
3—16 yd. Steel Underframe Western Dump Cars.
10—1½ yd. Western Dump Cars.
2—10x16 Davenport 36 in. ga. Saddle Tanks.
1—11x16 American 36 in. ga. Saddle Tank.
1—9x14 Porter 4 ft. 8½ in. ga. Saddle Tank.
1—⅝ yd. Thew "O" Traction Shovel.

Walter A. Zelnicker Supply Co., St. Louis

Have you a plant for sale? Do you wish to purchase a plant? Are you in need of a superintendent or manager? Are you looking for a position as plant superintendent or manager? Advertise your wants in these columns for quick results.

Used Equipment

Rates for advertising in the Used Equipment Department: $2.50 per column inch per insertion. Minimum charge, $2.50. Please send check with your order. These ads must be paid in advance of insertion

FOR SALE

4—42" Pan Feeders.
1—78"x20' Revolving Screen.
1—78"x25' Revolving Screen.
Large quantity Belt Conveyor Equipment.
1100 cu. ft. Belted Air Compressor.
16"x30" Corliss Engine.
300 HP. 3 ph. 60 cy. 220 volt motor.

Wm. C. Johnson & Sons Machy. Co.
1001-3-5 No. 6th St., St. Louis, Mo.

FOR RENT AND SALE

20—12-yd. Western air dump cars, std. gauge.
50—60,000-lb. capacity flat and box cars.
1—Western standard gauge spreader, used sixty days.
1—Osgood 18 revolving shovel, traction wheels, No. 794, ¾-yd. bucket, built 1920.
1—Marion 76 steam shovel, No. 3503, std. gauge, weight 110 tons, used 10 months.
2—Ponte 40-S 1-yd. side discharge concrete mixers, with steam engine and boiler.
32—NEW 20-in. I-beams, 80 lbs. per foot, 40 ft. long, not drilled.
1—NEW Lakewood concrete chuting system.
6—NEW wood-burning locomotive-stacks.

Locomotives

1—50-ton 18x24-in. six-wheel switcher.
1—40-ton 17x24-in. four-wheel switcher.
2—NEW 24-ton six-wheel Porters, separate tender, 36-in. gauge.
2—18, 14 and 10-ton Vulcans, 36-in. gauge.

INDUSTRIAL EQUIPMENT CO.
McCormick Building Chicago, Ill.

IMMEDIATE DELIVERY

SEND US YOUR STEAM SHOVEL INQUIRIES
65x86 in. TRAYLOR JAW CRUSHER.
No. 18K GATES CRUSHER.
50-75 HP. Single Drum Hoists, 25 Cy. Motors.
40-50 HP. D.D. Hoists, 60 Cy., 220-440 V., 3 Ph.
Nos. 3-5-6-7½ & 8K CRUSHERS.
6 and 12 ton Gasoline Locomotives.
10x12 in. Steam Hoist, 3 Drum.
2—DISC CRUSHERS, 36" SYMONS.
100 TON 2½ YD. ELEC. SHOVEL.
50 to 5000 ft. Steam, Belt & Elec. Compressors.
JAW and ROLL CRUSHERS.
10-15 & 20 Ton Locomotive Cranes.
13x30 in., 9x14 in. and Other Jaw Crushers.
24x54 McLANAHAN ROLL CRUSHER.
Columbus Portable Conveyor, 25 ft. Eng. Dr.
Send us your inquiries for Steam Engine, Centrifugal Pumps, Quarry & Cont. Equip., Etc.
ROSS POWER EQUIP. CO., Indianapolis, Ind.

WANTED

One large gyratory or jaw crusher suitable for steam shovel operation, also elevator and screens for same.

One 150-H.P. slip ring motor, 60 cycle, 220-volt.
One ¾ or 1¼-yd. Electric Traction Shovel.

Watertown Stone Products Co., Inc.
Watertown, N. Y.

WANTED

33" Fuller Mill

This mill must be in good condition and guaranteed.

WISCONSIN LIMESTONE CO.
1102 First Nat'l Bank Bldg. Milwaukee, Wis.

FOR SALE

2 8x110' Rotary Kilns
6 5x6x7x110' Rotary Kilns
8 5x21' Tube Mills, Steel Lining
6 250 H.P. Oil City Water Tube Boilers
1 4' 6" x 40' Coal Dryer
1 No. 5 Gates Crusher
8 Krupp Ball Mills
4 Engines, 200 to 500 H.P.
8 33" Fuller Mills
Shafting, Pulleys, Bearings and Elevator Equipment, all in first-class operating condition.

50 Acres of Land and Five Buildings, Stone and Steel Construction.
Located at Stockertown, Pa.

ENGINEERING SALES COMPANY, Nashville, Tenn.
OLLIE LAWRENCE, Stockertown, Pa.

Machinery For Sale

DRYERS—Direct-heat rotary dryers, 3x25', 3½x25', 4x30', 5½x50', 6x60' and 7x60'; double shell dryers, 4x20', 5x30' and 6x35'; steam-heated air rotary dryers, 4x30' and 6x30'.

KILNS—Rotary kilns, 4x40', 5x50' and 6x70', 6x100', 7x80' and 8x110'.

MILLS—6x8', 6x5', 5x4', 3x3½' pebble and ball mills; 3' March mill; 42", 33" and 24" Fuller-Lehigh mills; 4½x20', 5x11', 5x20', 5½x22' and 6x20' tube mills; 7½x13", 9x15", 16x10" and 12x26" jaw crushers; one "Infant" No. 00, No. 0, No. 2, No. 3, and No. 9 Williams' swing hammer mills; one Kent type "G" mill; 24", 36" and 40" cage mills; 3' and 4½', 6' and 8' Hardinge mills; 18x12", 20x12" and 30x10" roll crushers; No. 0, No. 1 and No. 3 Sturtevant rotary crushers; one No. 2 Sturtevant ring roll crusher; 5 roll and 2 roll No. 1 and No. 000, No. 00 and No. 0 Raymond mills; one No. 3 and No. 4 and No. 7½ Telsmith breaker; one 36" Sturtevant emery mill; one 3 roll Griffin mill; 60" chaser mill.

SPECIALS—Five automatic package weighing machines; jigs; 6x8', 6x5' and 4x3' Newaygo vibrating screens; Richardson automatic scales; 8' and 10' Emerick air separators.

Air compressors.

W. P. Heineken, Engineer
95 Liberty Street, New York. Tel. Cortland 1841

1—59-ton standard gauge Baldwin 6-wheel saddle tank switcher.
1—40-ton American 4-wheel saddle tank switcher.
2—50-ton standard gauge Brooks 6-wheel switchers.
1—42-ton standard gauge Shay geared locomotive.
2—18-ton 36" gauge 4-wheel saddle tanks.
2—23-ton new 36" gauge Porter 6-wheelers, with tenders.
1—20-ton Industrial Loco. Crane.
1—14-B Bucyrus steam shovel, mounted on traction wheels.

BIRMINGHAM RAIL & LOCOMOTIVE CO.
Birmingham, Ala.

FOR SALE

No. 2 Allis-Chalmers Gates Gyratory Crusher.
No. 3 Austin Gyratory Crusher.
No. 6 Austin Gyratory Crusher.
Two American Process type 24x48" Rotary Dryers.
50' continuous steel bucket (8"x16") and chain elevator.
50' continuous bucket (7"x13") and belt elevator.
25 H.P. simple side crank Heilman steam engine.
125 H.P. 18"x24" side crank Atlas steam engine.
75 H.P. 13"x16" side crank Erie City steam engine.
Lidgerwood Standard double cylinder, two drum, 10"x12" hoisting or cableway engine.
Two 150 H.P. General Electric Co. Induction motors, voltage 440 or 220, shop numbers 625140 and 1164925.
Williams No. 9 Swing hammer, Universal type pulverizer.
Worthington 10" intake by 8" discharge by 20 cylinders steam pump.
25 tons of 40 to 60 lb. rails.
7—2 yard, all steel, 48" gauge end dump quarry cars.
One Sanderson cyclone No. 14 electric, contraction well drill and equipment.

ADDRESS
E. W. Cooper, Engineer
174 3rd Ave. No., Nashville, Tenn.

FOR SALE

Monarch Corliss Engine, Rolling Mill Type. Cylinders 20"x42". Diameter Flywheel 14 ft. Built for 78 R.P.M. Engine is in good condition.

JACKSON & CHURCH CO.
Saginaw, W. S., Mich.

FOR SALE

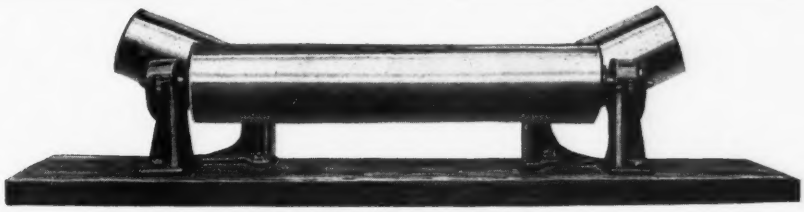
One (1) No. 6 McCully Crusher rebuilt by us—price $4000.00, with two (2) extra Master Wheels and one extra Shaft and Head. Subject to inspection in our shop and to prior sale.

R. S. NEWBOLD & SON CO.
Norristown, Pa.

FOR SALE

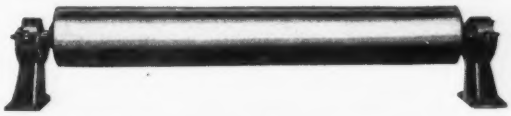
24" Symons Disc Crusher, never been used.

Breen Stone & Marble Co.
Kasota, Minnesota



BELT CONVEYOR CARRIERS

The Greenville Mfg. Co. is the maintenance and manufacturing department of the Greenville Gravel Co., who operate a dozen large sand and gravel washing plants and have been in the game for twenty years. Our belt conveyor carriers and return rollers were designed and are built for our own plants because we could find nothing on the market which would withstand the severe service required in handling gravel. They are of the ball-bearing, dust-proof, self-aligning type, made up of heavy pipe mounted on hubs, cast integral with cold rolled gudgeons; the whole machined after assembly to insure perfect concentricity. They have been thoroughly tried and have exceeded our expectations in our own plants, because they cost less, last much longer, and require almost no up-keep. Write for our catalogue on sand and gravel plant equipment.



We Manufacture

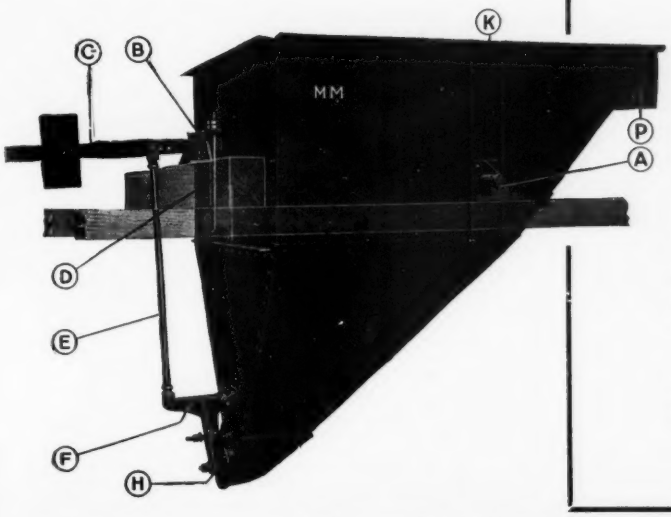
- Bin Gates
- Automatic Feeders
- All types of Screens
- Transmission Machinery
- Complete Belt Conveyors
- Complete Bucket Elevators
- Automatic Sand Settling Tanks

The Greenville Mfg. Co.

"Specialists in Sand and Gravel Plant Equipment"

GREENVILLE, OHIO

Only 5% Free Water in Telsmith Sand



The Telsmith Sand Tank and its counterweight-arm are both carried on knife-edge bearings, with a wide range of adjustment. As the tank pivots one way, the valve plate pivots in the OPPOSITE DIRECTION, giving ample discharge area with a short, snappy valve action. The movement of both members is short and rapid, discharging the sand in SMALL QUANTITIES but at FREQUENT INTERVALS. This action assures a deep sand-bed and a dry product. ***Absolutely automatic action guaranteed.***

Careful tests under operating conditions show that Telsmith sand contains under 5 per cent free water and a total moisture content under 25 per cent. No other tank dewaters so thoroughly. Send for Bulletin No. ST-11.

SMITH ENGINEERING WORKS 3188 LOCUST ST.

MILWAUKEE, WISCONSIN

Buyers' Directory
of the Rock Products Industry
Classified Directory of Advertisers in Rock Products

AERIAL TRAMWAYS
Interstate Equip. Co., New York, N. Y.

AIR COMPRESSORS
Bury Compressor Co., Erie, Pa.
Ingersoll-Rand Co., New York City, N. Y.

AUTOMATIC WEIGHERS
Schaffer Eng. & Equipment Co., Pittsburgh, Pa.

BAGS AND BAG MACHINERY
Bates Valve Bag Co., Chicago, Ill.
Jaite Co., The, Jaite, Ohio.

BARREL MAKING MACHINERY
Stoll Co., The D. H., Buffalo, N. Y.

BINS
Brown Hoisting Machinery Co., Cleveland, Ohio.
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill. (storage).

BIN GATES
Allis-Calmers Mfg. Co., Milwaukee, Wis.
Brown Hoisting Machinery Co., Cleveland, Ohio.
Link-Belt Co., Chicago, Ill.
Sturtevant Mill Co., Boston, Mass.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

BLASTING SUPPLIES
Du Pont de Nemours & Co., Wilmington, Del.

BOILERS, WASTE HEAT
Edge Moor Iron Co., Edge Moor, Del.
Freeman Mfg. Co., Racine, Wis.

BUCKETS—Elevator
Brown Hoisting Machinery Co., Cleveland, Ohio.
Haiss Mfg. Co., The Geo., New York City, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Link-Belt Co., Chicago, Ill.
Orton & Steinbrenner, Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.

BUCKETS, GRAB
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Machinery Co., Cleveland, Ohio.
Haiss Mfg. Co., The Geo., New York City, N. Y.
McMyler Interstate Co., Cleveland, Ohio.

CABLEWAYS
Flory Mfg. Co., S., Bangor, Pa.
Interstate Equip Co., New York, N. Y.
Link-Belt Co., Chicago, Ill.

CALCINING MACHINERY
Atlas Car & Mfg. Co., Cleveland, Ohio.
Butterworth & Lowe, Grand Rapids, Mich.
Ehrsam & Sons Co., J. B., Enterprise, Kans.

CARS—Quarry and Industrial
Atlas Car & Mfg. Co., Cleveland, Ohio.
Easton Car & Construction Co., Easton, Pa.
Ottumwa Iron Works, Ottumwa, Iowa.
Watt Mining Car Wheel Co., Barnesville, Ohio.

CAR PULLERS
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CEMENT MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Kennedy-Van Saun Mfg. & Eng. Corp., New York City.

CHAINS—All Kinds
Morse Chain Co., Ithaca, N. Y.

CLUTCHES
Webster Mfg. Co., Chicago, Ill.

CONVEYORS AND ELEVATORS
Haiss Mfg. Co., The Geo., New York City, N. Y.
Kennedy-Van Saun Mfg. & Eng. Corp., New York City.
Link-Belt Co., Chicago, Ill.
Smith Eng. Works, Milwaukee, Wis.
Robins Conveying Belt Co., New York City.
Sturtevant Mill Co., Boston, Mass.
Universal Road Mach. Co., Kingston, N. Y.
Webster Mfg. Co., Chicago, Ill.

CRANES—Locomotive Gantry
Brown Hoisting Machinery Co., The, Cleveland, Ohio.
Byers Mach. Co., The, Ravenna, Ohio.
Erie Steam Shovel Co., Erie, Pa.
Link-Belt Co., Chicago, Ill.
McMyler-Interstate Co., Cleveland, Ohio.
Northwest Engineering Co., Green Bay, Wis.
Ohio Locomotive Crane Co., Bucyrus, Ohio.
Orton & Steinbrenner, Chicago, Ill.
Osgood Co., The, Marion, Ohio.

CRUSHERS AND PULVERIZERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Austin Mfg. Co., Chicago, Ill.
Buchanan Co., Inc., C. G., New York, N. Y.
Butterworth & Lowe, Grand Rapids, Mich.
K. B. Pulverizer Co., New York, N. Y.
Kennedy-Van Saun Mfg. & Eng. Corp., New York, N. Y.
Kent Mill Co., Brooklyn, N. Y.
Lewistown Fdry. & Mach. Co., Lewistown, Pa.
McLanahan-Stone Mach. Co., Hollidaysburg, Pa.
Munson Mill Machinery Co., Utica, N. Y.
Pennsylvania Crusher Co., Philadelphia, Pa.
Raymond Bros. Impact Pulv. Co., Chicago, Ill.
Smith Eng. Works, Milwaukee, Wis.
Sturtevant Mill Co., Boston, Mass.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Universal Crusher Co., Cedar Rapids, Iowa.
Universal Road Mach. Co., Kingston, N. Y.
Williams Pat. Crush. & Pulv. Co., Chicago, Ill.

CRUSHER REPAIRS—Manganese Steel
American Manganese Steel Co., Chicago Heights, Ill.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

CLUTCHES
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

DERRICKS
American Hoist & Derrick Co., St. Paul, Minn.
Mundy Hoisting Engine Co., J. S., Newark, N. J.

DIPPER TEETH
American Manganese Steel Co., Chicago Heights, Ill.

DREDGING MACHINERY
Flory Mfg. Co., S., Bangor, Pa.

DRILLS
Sanderson Cyclone Drill Co., Orrville, Ohio.

DRILLERS
Pennsylvania Drilling Co., Pittsburgh, Pa.

DRYERS
American Process Co., New York City.
Vulcan Iron Works, Wilkes-Barre, Pa.
Weller Mfg. Co., Chicago, Ill.

DUST COLLECTING SYSTEMS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

DYNAMITE
Du Pont de Nemours & Co., Wilmington, Del.

ENGINES—Steam
Morris Mach. Works, Baldwinsville, N. Y.

ENGINEERS
Buckbee Co., J. C., Chicago, Ill.
Crow, Waller, Inc., Chicago, Ill.
Ehrsam & Sons Co., J. B., Enterprise, Kans.
Hunt, R. W., & Co., Chicago, Ill.
Schaffer Eng. & Equip. Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago, Ill.

EXCAVATORS
Bay City Dredge Works, Bay City, Mich.
Brown Hoisting Machinery Co., Cleveland, Ohio.
Erie Steam Shovel Co., Erie, Pa.
Northwest Eng. Co., Green Bay, Wis.

EXCAVATORS—Dragline Cableway
Link-Belt Co., Chicago, Ill.
Northwest Engineering Co., Green Bay, Wis.
Sauerman Bros., Chicago, Ill.

EXPLOSIVES
Du Pont de Nemours & Co., Wilmington, Del.

GAS PRODUCERS
Morgan Construction Co., Worcester, Mass.

GEARS
Cleveland Worm & Gear Co. Cleveland, Ohio.
Link-Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

(Continued on page 76)

Buyers' Directory
of the Rock Products Industry
Classified Directory of Advertisers in Rock Products

(Continued from page 74)

GENERATORS
Burke Electric Co., Erie, Pa.

GLASS SAND EQUIPMENT
Lewistown Fdy. & Mach. Co., Lewistown, Pa.

GRINDING MILLS
Munson Mill Machinery Co., Utica, N. Y.

HOISTS
American Hoist & Derrick Co., St. Paul, Minn.
Flory Mfg. Co., S., Bangor, Pa.
Link-Belt Co., Chicago, Ill.
Ottumwa Iron Works, Ottumwa, Iowa.
Thomas Elevator Co., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.
Weller Mfg. Co., Chicago, Ill.

HYDRATING MACHINERY
Atlas Car & Mfg. Co., Cleveland, Ohio
Kritzer Co., The, Chicago, Ill.
Miscampbell, H., Duluth, Minn.
Schaffer Eng. & Equip. Co., Pittsburgh, Pa.
Toepfer & Sons Co., W., Milwaukee, Wis.

HYDRAULIC DREDGES
Morris Machine Works, Baldwinsville, N. Y.

LIME HANDLING EQUIPMENT
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

LIME KILNS
Blaw-Knox Co., Pittsburgh, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

LOADERS AND UNLOADERS
Brown Hoisting Machinery Co., Cleveland, Ohio.
Erie Steam Shovel Co., Erie, Pa.
Haiss Mfg. Co., The Geo., New York City, N. Y.
Link-Belt Co., Chicago, Ill.
Orton & Steinbrenner, Chicago, Ill.

LOCOMOTIVES
Baldwin Locomotive Works, The, Philadelphia, Pa.
Brookville Truck & Tractor Co., Brookville, Pa.
Fate-Root-Heath Co., Plymouth, Ohio.
Hadfield-Penfield Steel Co., Bucyrus, Ohio.
Industrial Equip. Co., Minster, Ohio.
Lima Locomotive Works, New York, N. Y.
Vulcan Iron Works, Wilkes-Barre, Pa.
Whitcomb Co., Geo. D., Rochelle, Ill.

MAGNETIC PULLEYS
Magnetic Mfg. Co., Milwaukee, Wis.

MANGANESE STEEL
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

MOTOR TRUCKS
Traylor Eng. & Mfg. Co., Allentown, Pa.

PAINT AND COATINGS
Williams, C. K., & Co., Eaton, Pa.

PERFORATED METALS
Cross Eng. Co., Carbondale, Pa.
Hendrick Mfg. Co., Carbondale, Pa.

PLASTER MACHINERY
Butterworth & Lowe, Grand Rapids, Mich.
Ehrsam & Sons Co., J. B., Enterprise, Kans.

PORTABLE CONVEYORS
Haiss Mfg. Co., The Geo., New York City, N. Y.
Link-Belt Co., Chicago, Ill.

POWDER
Du Pont de Nemours & Co., Wilmington, Del.

POWER TRANSMITTING MACHINERY
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.

PUMPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Manganese Steel Co., Chicago Heights, Ill.
Morris Machine Works, Baldwinsville, N. Y.
Traylor Eng. & Mfg. Co., Allentown, Pa.

PULLEYS
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

PULVERIZED FUEL EQUIPMENT
Raymond Bros. Impact Pulv. Co., Chicago, Ill.

QUARRY EQUIPMENT
Universal Road Mach. Co., Kingston, N. Y.

ROAD MACHINERY
Austin-Western Road Mach. Co., Chicago, Ill.

ROPE, WIRE
American Steel & Wire Co., Chicago, Ill.
Leschen, A., & Sons Co., St. Louis, Mo.

SCALES
Richardson Scale Co., Passaic, N. J.

SCRAPERS, DRAG
Link-Belt Co., Chicago, Ill.
Sauerman Bros., Chicago, Ill.

SCREENS
Cross Eng. Co., Carbondale, Pa.
Haiss Mfg. Co., The Geo., New York City, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Link-Belt Co., Chicago, Ill.
Smith Eng. Works, Milwaukee, Wis.
Sturtevant Mill Co., Boston, Mass.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Tyler Co., The, W. S., Cleveland, Ohio.
Universal Road Mach. Co., Kingston, N. Y.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

SEPARATORS
Raymond Bros. Impact Pulv. Co., Chicago, Ill.
Sturtevant Mill Co., Boston, Mass.
Tyler Co., The W. S., Cleveland, Ohio.

SEPARATORS, MAGNETIC
Buchanan Co., C. G., Inc., New York, N. Y.
Magnetic Mfg. Co., Milwaukee, Wis.

SHEAVES
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

SHOVELS—Steam, Electric and Gas
Bay City Dredge Works, Bay City, Mich.
Brown Hoisting Machinery Co., Cleveland, Ohio.
Erie Steam Shovel Co., Erie, Pa.
Northwest Eng. Co., Green Bay, Wis.
Orton & Steinbrenner Co., Chicago, Ill.
Osgood Co., The, Marion, Ohio.

SPROCKETS
Link-Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

SPROCKET CHAIN
Webster Mfg. Co., Chicago, Ill.

STEEL PLATE CONSTRUCTION
Blaw-Knox Co., Pittsburgh, Pa.
Hendrick Mfg. Co., Carbondale, Pa.

STORAGE BINS
Brown Hoisting Machinery Co., Cleveland, Ohio.

STUCCO FACINGS
Metro-Nite Co., Milwaukee, Wis.

SWITCHES AND FROGS
Central Frog & Switch Co., Cincinnati, Ohio.

TANKS, STEEL STORAGE
Blaw-Knox Co., Pittsburgh, Pa.
Traylor Eng. & Mfg. Co., Allentown, Pa.

TESTING SIEVES AND TESTING SIEVE SHAKERS
Tyler Co., The W. S., Cleveland, Ohio.

TRAMWAYS
Interstate Equip. Co., New York, N. Y.

TRANSMISSION MACHINERY
Link-Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., Chicago, Ill.

WASHERS, SAND AND GRAVEL
Link-Belt Co., Chicago, Ill.
Smith Eng. Works, Milwaukee, Wis.

WEIGHING EQUIPMENT
Richardson Scale Co., Passaic, N. J.

WIRE ROPE
American Steel & Wire Co., Chicago, Ill.
Leschen, A., & Sons Co., St. Louis, Mo.

WIRE CLOTH
Cleveland Wire Cloth Co., Cleveland, Ohio.
Tyler Co., The W. S., Cleveland, Ohio.

Austin Motor Rollers

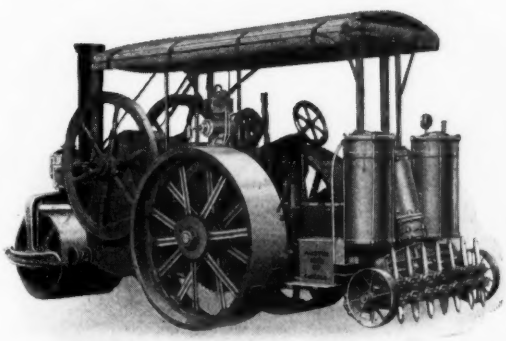
"They Serve You Right"

Everything you expect of a road roller you will find in the Austin Motor Roller to a greater degree than in any other.

Economical to operate and maintain, able to turn out more work in a given time than any other, and absolutely reliable—your first experience with one of these machines will be a revelation of REAL ROLLER SERVICE.

Three-wheeled rollers in two styles (single or twin engines) and five sizes (7, 8, 10, 12 and 15 ton)—there is a style and size exactly suited to your individual requirements. Pneumatic scarifier can be attached to the 10-ton and larger sizes, as shown in the photographs.

Special Catalog FT tells the whole story of Austin Motor Rollers. Write for your copy today.



THE AUSTIN-WESTERN ROAD MACHINERY CO.
CHICAGO

Branches in 22 Cities

"Everything from a Drag Scraper to a Road Roller"

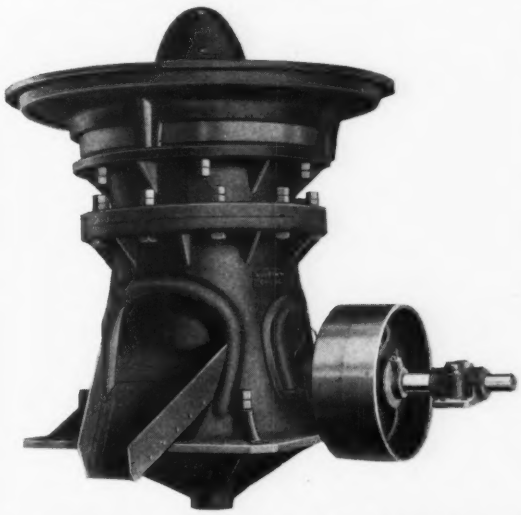
Everybody's Happy

By crushing, screening and storing rock obtained from nearby fields during the past winter, the Highways Improvement Company of South Bend, Ind., secured the material for a six-mile contract much cheaper than if they had had it shipped in, and at the same time kept their organization together and got rid of field stones and made money for the farmers in the district where the road was built.

A survey of the farms along the road was made after the contract was awarded and it was decided that enough stone could be secured from the fields to make it pay to put in a portable crushing and screening plant. The plant was set up at the middle point of the new road, and stone hauled in by farmers from within a radius of four miles.

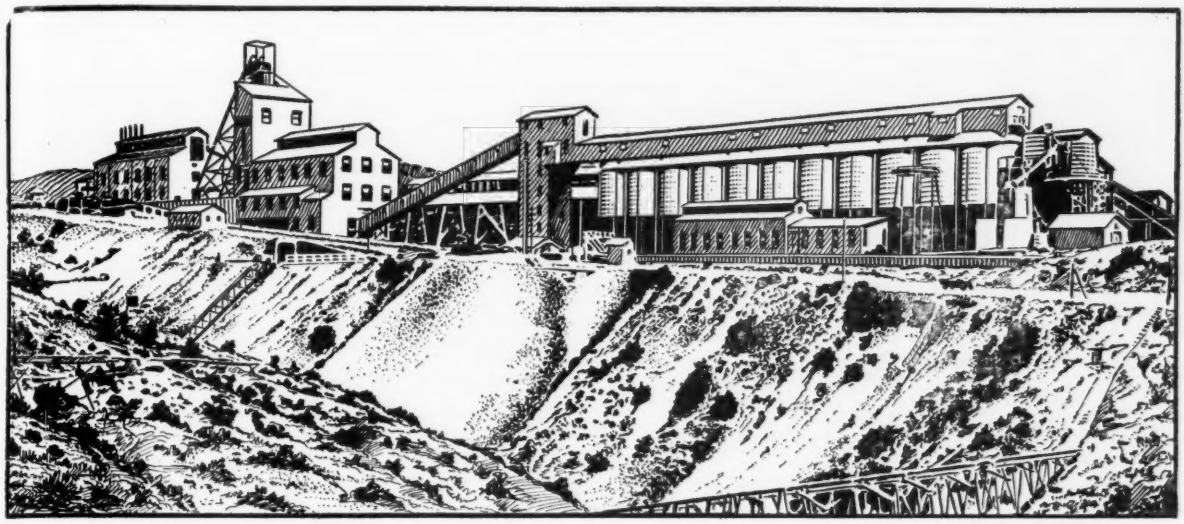
Crushing and screening reduced the stone to four sizes, ranging from dust to 4 in. The several sizes were stored in separate piles more than 20 ft. high by means of the conveyor, so little ground space was required and the material was in shape to be reclaimed quickly when taken out for the road.

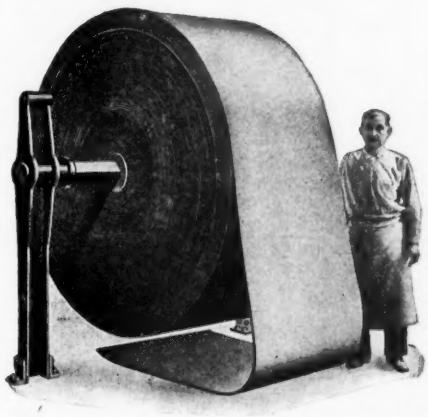
Catalog 29-T tells all about the No. 3 Austin Portable Gyratory Crushing and Screening Plant that helped to make this such a profitable venture. Write for your copy now.



AUSTIN MANUFACTURING CO.
New York Chicago San Francisco

INDEX TO ADVERTISEMENTS





Conveying 9,357,000 Tons of Ore With One Belt

Read This Remarkable Record Made at Miami Copper Company's Mine

Seven years' service from this conveyor belt is the record run made at Miami, a period of usefulness extending through the rush of war production.

The belt cost for conveying this huge quantity of ore is 66/1000 of a cent per ton, truly a remarkable figure for any service.

Width of belt, 30 inches.
Number of plies, 6.
Thickness of cover:
Conveyor side, ⅛ inch.
Pulley side, 1/32 inch.
Date installed, March 11, 1911.
Date taken off, June 1, 1918.

This belt was installed in two sections. The inclined belt, operating at an angle of 3½ inches in 12 inches is 530 feet in length, and the horizontal belt which distributes ore to the bins is 680 feet long.

This installation is an example of a conveyor belt designed by our belt men after careful investigation of all the operating conditions.

These facts determine the character of the rubber compounds used, the kind and weight of duck, and the correct number of plies.

The result is a belt of wear-defying construction that comes through the test of heavy work with cost figures well on the credit side.

Before you buy another conveyor belt, send us the particulars regarding your requirements and we will gladly make recommendations for a suitable belt and submit costs.

NEW YORK BELTING & PACKING CO.

New York
Boston
Chicago
El Paso
Philadelphia
Pittsburgh
St. Louis
Salt Lake City
San Francisco

CONVEYOR BELTING FOR HEAVY MINING SERVICE